OAHU GROUND WATER CONTROL

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Report No. 8 – 1948

Legislative Reference Bureau
University of Hawaii

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-- Report No. 8, 1948 --
(Request No. 277)

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Over the centuries, rain water percolating down through the porous rock of Oahu has built up underground, floating on and pushing downward the salt water of the ocean which normally would extend through the Island at about sea level. Where there are no obstructions, this fresh water passes into the ocean at the sea shore, but due to subterranean dikes, some water is trapped above sea level (perched water) and in other areas, the excess is unable to pass easily into the ocean because of overlying, impervious caprock. In the latter areas, water is thus built up under pressure and is known as artesian water.

The Island of Oahu relies heavily upon water obtained from underground sources. The lowering of the head in a number of artesian areas, and the gradual increase of the salt content of water withdrawn from deep artesian wells tends to indicate that from a long range viewpoint more water is being pumped from them than is being replaced by rain water percolating down. The possibility of developing major sources of additional ground water on Oahu appears limited. Rather than continuing to deplete water stored up through the centuries, future reliance must be placed on utilizing the current recharge of the ground water areas and capturing the portion of the ground water which would otherwise pass off into the ocean. If ground water consumption evidences a tendency to return to and advance beyond the all-time high of 1945, some system of control may well become a necessity. Meanwhile a potentially dangerous situation exists, but it is not one of acute emergency.

A review of the ground water in the 17 western states discloses that at least three different legal doctrines have been applied to determine ownership and the right to use underground waters. As a further complication, in the same state the right to water in subterranean streams, percolating waters, or artesian waters may be determined by the application of different legal doctrines. Here in the Territory, the law on underground waters is not clear, the courts having had no opportunity to develop an integrated body of adjudicated water law.

The proposed Oahu Ground Water Control Act (S. B. No. 200 and H. B. No. 418 of 1947) is designed to create a governmental agency with regulatory power over use of ground water on Oahu. Basic to the act is the declaration that all ground water is public property, that all vested rights to the beneficial use of ground water will continue, but that all new developments or increased use of ground water requires permission which will be granted only if there is sufficient water available. In case ground water resources become inadequate or endangered, withdrawals will be restricted in order of priority, with the last person receiving permission to use ground water having the lowest priority.

The constitutionality of the proposed Oahu Ground Water Control Act, at least in part, is questionable in view of a decision by the Hawaiian Supreme Court in 1929. However, comparable legislation has been adopted in a number of the western states to meet similar problems. Should the court be unwilling to follow the lead of these states when faced with a case which presents all aspects of the ground water problem, it may still hold constitutional those portions of the act relating to non-artesian waters, as well as the general regulatory features designed to prevent waste and pollution.

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1. Nature of Ground Water

Even with modern equipment and the refinement of technical skills, sources of water for human consumption, as well as for agricultural and industrial utilization remain limited in the Territory. Direct rain catchment is of minor importance and distillation of sea water does not yet appear to be economically feasible. Inducement of rain for irrigation of crops by dry ice bombardment is in the experimental stage. Prime sources of water still remain limited to two catagories--underground water and surface water, the latter in the form of springs, streams, or bodies similarly confined within channels or banks. Both categories are derived from rainfall. For islands like Oahu where surface water is of relatively less importance and apparently a major portion of the water used is obtained directly from underground sources, the safeguarding of ground water supplies is fundamental.[1]

Fresh water lens:

A peculiar phenomena of Oahu and other similar Pacific Islands is that though they are completely surrounded by salt water, the island itself is not saturated with salt water along the imaginary line of sea level extended horizontally through the island. Fed by rainfall, a body of fresh

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[1]See Part 2 of this report for a discussion of surface and ground water consumption. As this report has been prepared as background for consideration of the proposed "Oahu ground-water control act," discussion of the nature of ground water is limited to a treatment of the ground water supply of Oahu, only. For ground water supplies on the other Hawaiian Islands, see: Stearns, H. T. and MacDonald, G.A., Geology and Ground-Water Resources of the Island of Molokai, Hawaii (1947). Stearns, H. T. and MacDonald, G. A., Geology and Ground-Water Resources of the Island of Hawaii, Hawaii (1946). Stearns, H. T. and MacDonald, G. A., Geology and Ground-Water Resources of the Island of Maui, Hawaii (1942). Stearns, H. T., Geology and Ground-Water Resources of Lanai and Kahoolawe, Hawaii (1940).

water grows underground, and being lighter than salt water, floats on it and tends to push the salt water down and towards the island's periphery. Visualizing this, it will be seen that this body of fresh water takes the shape of a double-convex lens (technically known as the Ghyben-Herzberg lens) which is curved so as to be approximately forty feet under sea level for every foot of fresh water above sea level, and, if all the rock of the island were equally highly permeable, would appear like the following simplified diagram:

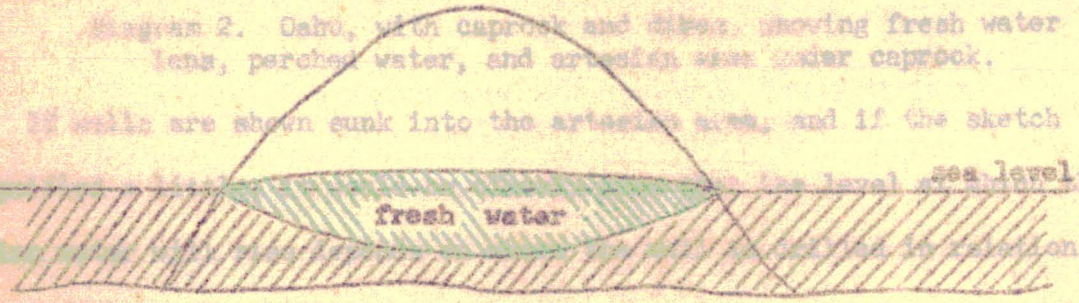


Diagram 1. Oahu, if rock were all equally highly permeable, showing fresh water lens (upper lens exaggerated).

In fact, Oahu is composed of various types of rocks and soils. These all contribute to a distortion of the theoretical shape of the water lens (see Diagram 2). Dikes of hard rock thrust through the basalt prevent some of the rain water from percolating down, or slow the percolation, so that bodies of water, called perched water, are stranded high above sea level like hidden, rock-bound water tanks. In other places as, for example, the Oahu coastal plain upon which a large part of Honolulu is built, over-lying strata of relatively impervious rock (caprock) prevent the fresh water underneath them from rising to the height it would tend to reach if not so confined. This water is thus under pressure, or in other words, is artesian water. If a hole is bored through the caprock, the water will rise up the well, the height being dependent upon the pressure in the artesian basin. Sometimes it

will even rise higher than the well mouth, and as it spurts up, resembling a geyser, is the prototype of the popular conception of an artesian well.

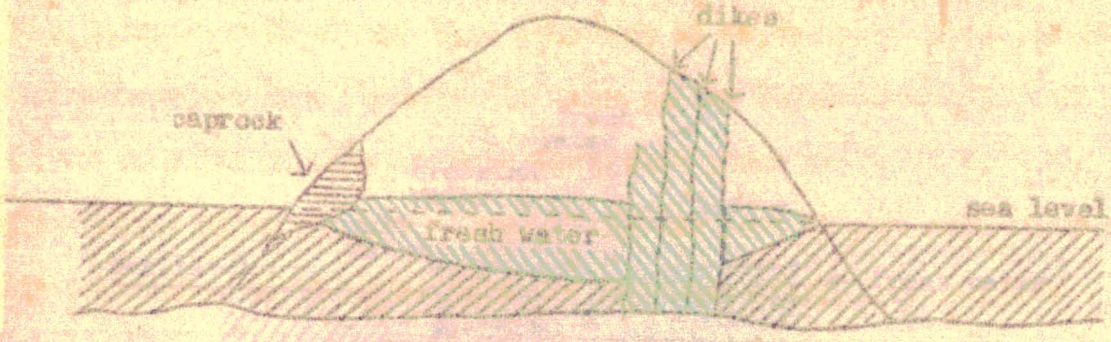


Diagram 2. Oahu, with caprock and dikes, showing fresh water lens, perched water, and artesian area under caprock.

If wells are shown sunk into the artesian area, and if the sketch is magnified a little, it would be clearly seen that the level at which the artesian water will rise depends on where the well is drilled in relation to the underlying fresh water:

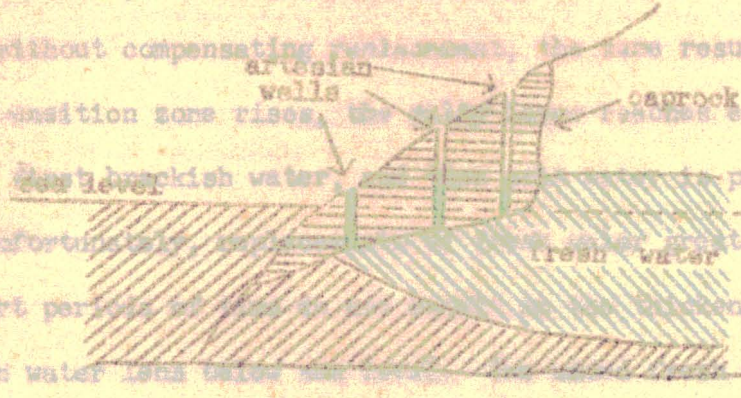


Diagram 3. Artesian area under caprock, showing rise of water in wells drilled into area.

Should there be large withdrawals from the fresh water lens through wells, without compensating replacement, the lens will grow thinner. If all of the fresh water were withdrawn, salt water would tend to rise to the line of sea level extended horizontally through the island. However, even before that state is reached, the remaining small amount of fresh water would become partially salty and unusable. This is because the zone between the overlying

fresh water and the salt water beneath is not one of sharp differentiation, but one of gradual transition from salt to fresh:

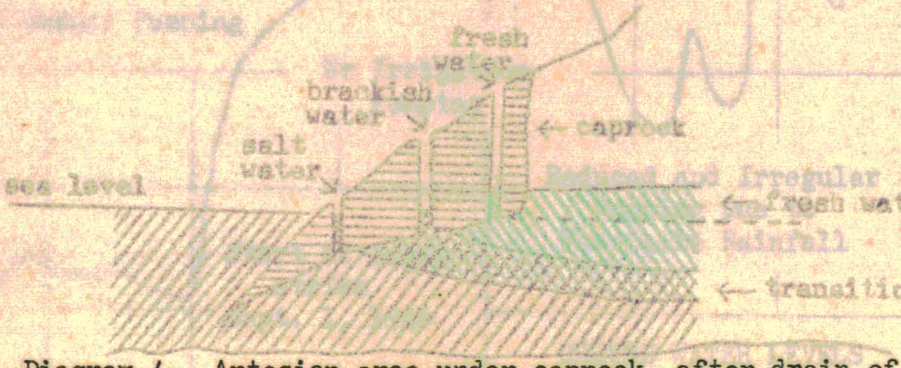
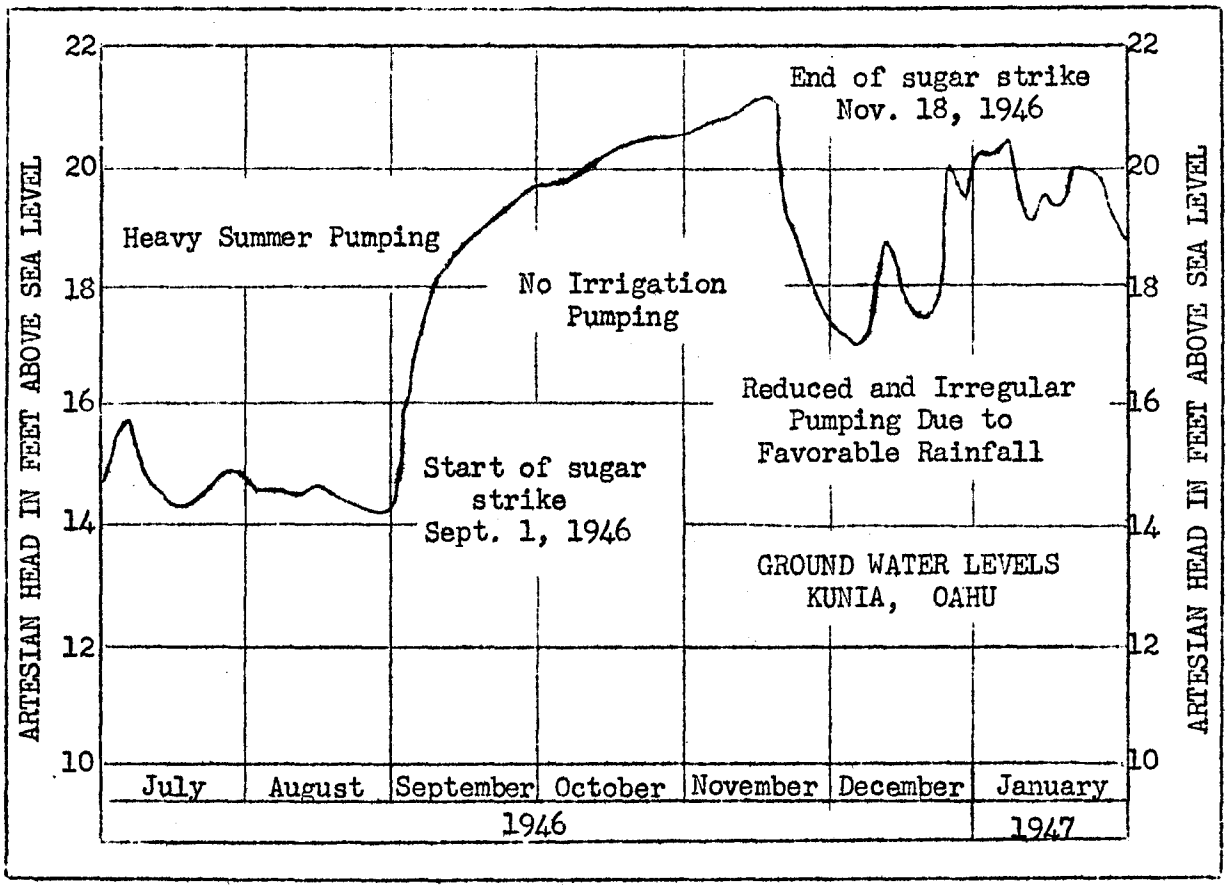


Diagram 4. Artesian area under caprock, after drain of lens without compensating replacement.

Water under artesian pressure makes up only a part of the ground water of Oahu. If a sketch of a water basin not under pressure were drawn, wells tapping it shown, and then the fresh water lens contracted by water withdrawals without compensating replacement, the same result would be observed. As the transition zone rises, the salty layer reaches ever closer to the wells, until at first brackish water, and then salt water is pumped.

Unfortunately, replacements of fresh water greater than withdrawals over short periods of time do not result in the thickening of the portion of the fresh water lens below sea level. The added fresh water tends to raise the water level, and in effect to increase the thickness of that portion of the lens which lies above sea level. This is well illustrated by the following diagram showing the rapid increase of the ground water level in the Pearl Harbor artesian area which occurred after cessation of irrigation pumping during the 1946 sugar strike. It is patently obvious that for the seven-foot rise of the artesian head in the short period of three months, 280 extra feet of water (7 x 40, see page 2) could not be added to the portion of the lens lying below sea level.



Source: Eleventh Biennial Report of the Board of Water Supply, City and County of Honolulu, p. 28.

Over long periods of time, an equalizing adjustment could be expected in the lower portion of the lens and a new equilibrium reached; the volume of fresh water over sea level should increase as the weight of the fresh water displaces the salt water, but this is not a matter of weeks, or months, but may take decades.

Actually the trend has constantly been to withdraw more water than is replaced (as is evidenced by the declining heads in the artesian areas) and all reversals of the trend have been of relatively short duration. Thus, even if less water is withdrawn for a short period and the water level rises, the encroachment of the salty transition zone may continue, possibly at a reduced rate, the gradual transition from fresh to salt water being a long term

phenomenon. At best, once wells become salty, increase of well head may permit drawing of water at higher levels, and thus above the salty transition zone, but this brackish zone will be encountered at relatively the same depth, despite the increased head.

Although theoretically the fresh water lens should extend from seashore to seashore, the axis being thickest at the island's center, actually such a symmetrical shape is not maintained. All of the rock of Oahu is not equally porous; dikes of hard rock interrupt the fresh water lens, and in some areas lava flows alternate with layers of alluvium. Thus, in fact, many underground water areas will be found, all lying relatively within the limits of the fresh water lens or perched above it due to the rock formations. These underground areas are separate and not directly connected. For example, twelve artesian basins have been mapped on Oahu, and this does not take into consideration areas where ground water is found but not under pressure. Lowering or raising the level of fresh water in one area will not have an immediate effect on the others. However, over a long period of time, it is believed that changes in one area will be reflected in others due to the percolation of water from one to another or the diversion of percolating waters.

Three forms of ground waters:

All water in the ground does not exist in the form of a subterranean basin in which all voids and interstices between the rocks are filled with water. Rain water percolates down, following no known fixed channel. Underground waters sometimes flow in well defined channels like underground streams or rivers. Thus, three forms of underground water may be differentiated -- percolating water, water moving in well-defined channels, and subterranean

basins of water. In the latter class are the basal waters previously discussed and high level water, or perched water, graphically portrayed in Diagram 2 on page 3.

These three forms do not exist each independent of the other. Percolating water may ultimately be canalized into an underground stream and the latter may feed a subterranean basin, or, percolating water may continue filtering down until it reaches a basin. Mention has previously been made of percolation occuring between basins. Then, too, all water underground does not necessarily remain there; it may feed a surface stream or spring or pass into the ocean at the point where the fresh water lens meets the salt water of the ocean. An example of the latter is furnished by the springs in the Pearl Harbor area which have a measured discharge of some 68 million gallons daily. To this amount, some 11 m.g.d. are added from tunnels and wells, and of the total 79 m.g.d., around 59 m.g.d. pass into the sea (see Appendix C).

Ground water hydrologists assert that this tri-fold division--percolating water, water moving in well-defined channels, and subterranean basins--is unrealistic, as one form may merge into the others, and it is extremely difficult to isolate the legal rights with relation to one without considering the interdependence of all three.[2] Be that as it may, the courts recognize

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[2]The subcommittee on state water law appointed by the water resources committee of the National Resources Planning Board in its report on state water law accepted the concept that an elaborate classification of ground water is neither justified nor necessary; that all water in the part of the earth known as the zone of saturation is purely and simply ground water, moving according to well recognized laws of physics; and that its recommended legislation should be applied to all such waters which appear to be susceptible to legal control, whether such waters at any given moment are moving (percolating) through the interstices of the earth or whether (as in the case of some areas) they are concentrated in subterranean bodies which are essentially motionless. State Water Law in the Development of the West, Report of the Water Resources Committee of the National Resources Planning Board by the Subcommittee on State Water Law (July, 1943), p. 70.

Stearns would divide all ground water in the Territory into (1) basal

different sets of rights depending upon which of the three forms of underground water is under consideration. (See Parts 3 and 4 of this report for discussion of legal rights.)

2. Oahu Water Resources and Consumption

Ground water resources:

The problem of estimating ground water supplies in Oahu has yet to be solved. Moderately accurate figures for certain areas are available but the refining of the estimates beyond the first approximation is extremely difficult.[3] Then, too, estimates of ground water supplies are of little use in and of themselves. It is only when they are considered with relation to water withdrawals, trends in water levels of artesian areas, salinity content of withdrawn water, rainfall statistics, and the like, that they assume their proper perspective. Inherent in the estimates are assumptions on the interrelation of the various forms of fresh ground water, the separate identity of the several bodies of stored ground water, the relation of some of these to salt ocean water, and the extent of water supplies in areas untapped and only partly surveyed. Availability of water must also be measured in terms of distance and expense--perhaps erection of a plant at a remote spot to divert water so that it will percolate down to feed an artesian area near at hand may

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[2](Continued) ground water, and (2) high level ground water. Stearns, Harold T., "Ground Water Resources" in First Progress Report of the Territorial Planning Board (1939), p. 142.

[3]See Wentworth, Chester K., "Progress in the Estimating of Ground Water Supplies in Hawaii." Transactions, American Geophysical Union. Vol. 28, No. 2, p. 266. April 1947. Data on the Beretania artesian area as found incorporated in this portion of the report have been supplies through the courtesy of Dr. Wentworth, and similarly, estimates of Oahu's ground water resources are in part based upon data he has furnished.

be cheaper than piping that water from the distant point.[4]

A detailed case in point may illustrate the problem. The Beretania artesian area in the City of Honolulu offers the most reliable, long-term records. From a level of 42 feet above sea level in 1889, the water dropped to a low of 23.5 feet above sea level in 1926. During the same period water withdrawals from artesian wells in the area rose from an amount probably less than 3 million gallons daily to about 16 or 18 million gallons daily in 1926. The salinity content of certain wells near the coast increased sufficiently to render the water from these wells unfit for ordinary use.

Due in part to a conservation program, commencing in 1926 the water level in the Beretania artesian area eventually reached a peak of 33.3 feet above sea level in 1938. During the same 12 years from 1926 to 1938, the rainfall for the recharge area of the artesian basin was almost precisely average.

Meanwhile from 1929 to 1934 the total amount of water distributed by the Board of Water Supply from all sources continued to decrease, and this was also true of the amount withdrawn by owners of private wells in this and other sections of the City of Honolulu. Beginning in 1935 withdrawals of water took an upswing, both from the Beretania area and from the other sources tapped by the Board. Until 1939 the yearly increases were small, but marked increases took place with the advent of military defense work. By 1944, approximately 15 million gallons a day was being pumped from the Beretania artesian area by both the Board and private well owners, and the total of withdrawals by the Board from all sources had become double the average for

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[4]The Honolulu Board of Water Supply contemplates undertaking two projects which will convey stream water, by means of small diversion dams, into horizontal tunnels driven into the Koolau lava permitting water to percolate down into the artesian aquifer.

the decade 1930-39. The artesian water levels of the Beretania artesian area again started receding in 1939, and saline increase was shown both in the amounts in any given well and in the number of wells showing such a change. This unfavorable trend continued until the summer of 1946 when the Beretania artesian level reached an all-time low of 22.07 feet above sea level. Salinity at about this time also reached the highest known values in certain wells and has only within the past year become slightly reduced by the improved artesian levels attained in 1947 and 1948. These have come about partly by return of rainfall amounts to nearly normal and partly by moderate but steady reductions of draft since the end of the war.

These figures show a dependence of the water level of the Beretania artesian area upon the volume of water withdrawn. The amount of precipitation appears to have temporary effects, which average themselves during longer periods. More difficult to determine is how far total withdrawals by the Board from all its sources of water influenced the water level of the Beretania artesian area, but it seems clear that the recovery of this artesian level was aided in some degree by delivery of water from the Board's Halawa station in the Pearl Harbor area, thus partially diverting demand from the Beretania area.

The dropping of the artesian water level indicates a shrinkage of the thickness of the fresh-water lens. Starting with a lens some 1,600 feet thick, this has probably been reduced to under 1,000 feet. By every plausible calculation, shrinkage of the thickness of the fresh-water lens by 600 feet represents a very large amount of water, perhaps 30 years or more of annual increment to ground water.

The foregoing evidences the mass of details pertinent to the consideration of just one ground water area. It well illustrates the complexities

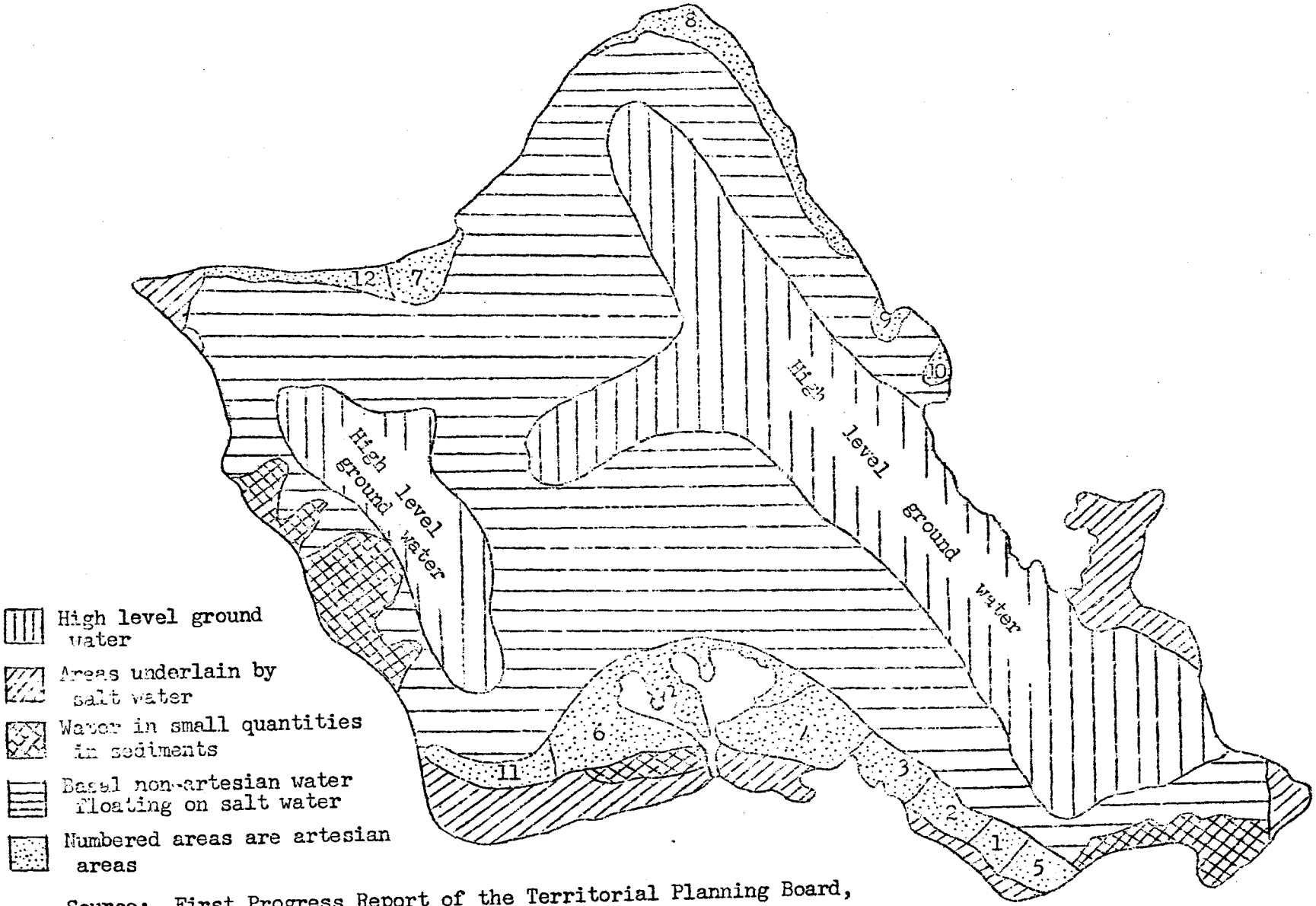
which complicate any attempt to estimate ground water resources available for use.

Diagram 5, Ground Water Area on Oahu, found on the following page indicates the location of the various forms of ground water encountered on the Island of Oahu. From Diamond Head to Barber's Point there are a number of artesian areas (1-6, 11). In addition there are artesian areas at Waialua Bay (7, 12), Kahuku Point (8), and near Kahana (9, 10). On most of the remainder of Oahu ground water is found either as high level groundwwater, or as basal, non-artesian water floating on salt water.

The view is entertained by students of the water supply problem that in a long-term sense there is little new ground water to be developed in the Honolulu region without eventual effect on the existing installations. The artesian and basal water of the area from Diamond Head to Pearl Harbor is under control of existing pumping stations and it is believed it will respond adversely to aggregate pumping rates materially in excess of present rates. The same may be true of the area from Pearl Harbor to Barber's Point. It is recognized that in those areas where pumping stations are widely spaced, additional pumping stations may to some degree permit the draft of more water at a given time without drastic increase in salinity. However, these additional stations which add to the total of water pumped may actually not develop new water sources but may only reduce some of the existing but obscure depletion of the present set-up.

The various ground water supplies which can be newly tapped or developed on Oahu will probably produce additional water amounting to not much more than 10 per cent of the total Oahu pumping from the chief artesian areas. As a result, the over-all picture of Oahu ground water resources is one that precludes reliance on the assumption that unlimited ground water supplies

Diagram 5. GROUND WATER AREAS ON OAHU



Source: First Progress Report of the Territorial Planning Board, 1939; plate 72, p. 148.

still remain available. Future development is possible, but compared to present ground water consumption, offers promise of relatively small additional supplies.

Ground water consumption:

Ground water may be obtained through drilling wells, digging shallow wells, sinking shafts, or driving tunnels at high levels from which water flows by force of gravity. The principal source on Oahu is from scattered drilled wells, but the trend is toward the use of shafts for the development of ground water.[5] If the pressure in an artesian area is great enough, tapping it by a well will result in the water's rising to the surface without need of pumping, but for purposes of computing consumption, water from wells is classed as pumped to differentiate it from gravity flow tunnels.

The statistics available give a fairly complete picture of ground water consumption on Oahu--at least the records of all major sources are complete and it may be reliably estimated that the total as computed from reported data would not be unduly effected by inclusion of the scattered users whose identity is known but whose consumption has not been measured.[6]

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[5]The ten shafts constructed between 1935 and 1940 were capable of delivering in the latter year more than a third of the entire yield of the 750 drilled and 100 dug wells on Oahu. Stearns, H. T., Supplement to Geology and Ground Water Resources of the Island of Oahu, 1940, p. 11. Ground water near the surface of the fresh water lens may be developed through inclined shafts without the same danger of increase in salt content which is existent when deep wells are utilized.

[6]The Territorial Division of Hydrography has records showing the location, depth, salinity, and water level of each of the private wells in rural Oahu, but not consumption of water, as the owners are not required to keep such records. Similarly, the total draft from shallow wells in the city of Honolulu which tap underground water in the caprock above the artesian areas is unknown. There are about 25 firms in downtown Honolulu which use this non-potable water for air conditioning and refrigeration, resulting in the conservation of several million gallons of pure water daily. In addition, there

For the year 1946, recorded ground water consumption consisted of:

Pumped ground water	117,512.41 million gallons
Gravity flow	7,888.64 million gallons
Total	125,401.05 million gallons

To this may probably be added another 10 per cent to cover shallow ground water draft, unrecorded gravity tunnel flow, and unrecorded deep wells in rural Oahu.

The recorded ground water consumed in 1946 is smaller than the previous six years, and is probably due in part to the sugar strike which halted pumping of ground water. Using the year 1934 as a base, total recorded ground water consumption in Oahu as well as for the Honolulu Board of Water Supply, alone, may be shown as follows:

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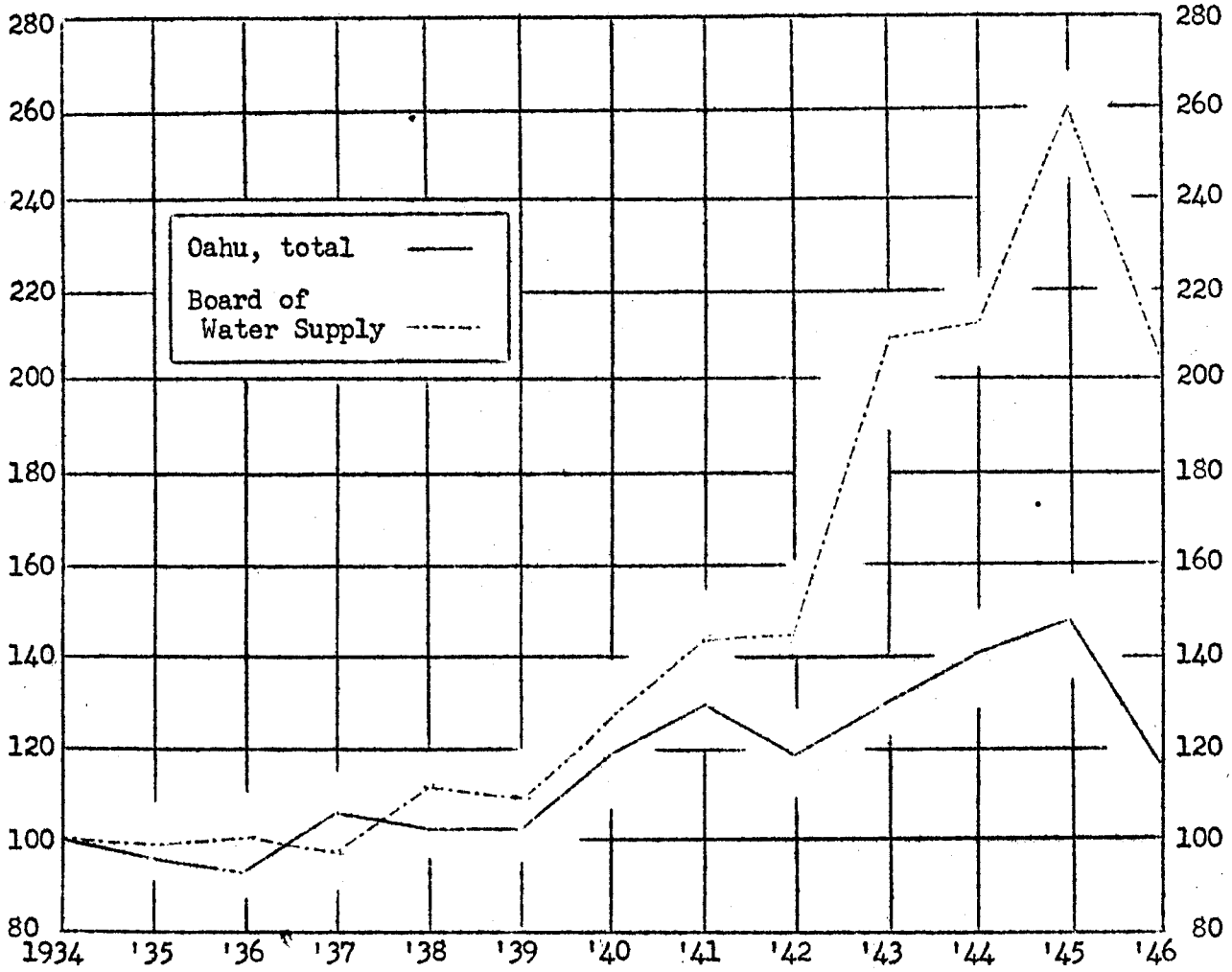
[6](Continued) is some agricultural use of this shallow underground water, but total consumption of shallow ground water on Oahu probably does not exceed 10 to 12 m.g. daily. Stearns estimated that the total water obtained from all wells in Oahu for 1937 other than from 8 named sources was 10,500 m.g., which would be about 10 per cent of the recorded ground water consumption for that year as shown in Appendix D and E. Stearns, H. T., "Ground-Water Resources" in First Progress Report of the Territorial Planning Board, 1939, p. 145.

Diagram 6. INCREASE OF RECORDED GROUND WATER CONSUMPTION, OAHU
(1934 = 100)



Source: Appendix D and E. Arbitrary assumptions of 1000, 2000, and 10,000 m.g. made for U.S. Army, U.S. Navy and Waiahole Tunnels, respectively, in years for which data lacking.

The year 1946 witnessed a decrease in United States Army and Navy recorded consumption from the 1945 high, and 1947 military consumption was even lower (8,914.12 m.g.). Despite the drop from the 1945 peak and the temporary leveling off over the last few years, it is reasonable to anticipate a long term consumption by the Honolulu Board of Water Supply at least as high as recorded for 1946, due to the City of Honolulu's increasing population, and the continued demand by the plantations for as much ground water

as was used in 1946, the exact amount actually consumed by the plantations being dependent on rainfall and other factors. Even if increased population does not force the Honolulu Board of Water Supply and the City and County suburban water system to develop additional facilities,[7] the encroachment of salt into the artesian areas would appear to require eventual construction of new shaft and tunnel facilities designed to eliminate or, at least, reduce reliance upon pumpage from deep artesian wells.

Surface water resources and consumption:

An attempt to determine the surface water resources of Oahu has revealed that no accurate estimate of yearly totals could be reached from the records available. At present there are only about two score gauging stations being maintained by the U. S. Geological Survey and the Territorial Division of Hydrography,[8] although the Geological Survey has, at one time or another, had a total of 90 gauging stations at various points on the Island.[9] In addition, the Honolulu Board of Water Supply and private agencies have a number of gauging stations. Unfortunately, records available show run-off for a particular stream but not its diversion, or amount of water diverted but not total run-off, and as a rule when either or both have been recorded, the scattered records for Oahu as a whole in any year do not permit an esti-

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[7]In 1947 the City and County suburban water system put the Kahaluu tunnel into service and the Waianae Tunnel is now in course of construction.

[8]U. S. Geological Survey Water Supply Paper No. 1015. This should not be interpreted as a criticism of the U. S. Geological Survey or of the Territorial Division of Hydrography, for without the necessary funds, the Division only maintains stations where the territorial government has an interest in the flow of a stream.

[9]As of 1938. Carson, Max H., "Surface-Water Resources" in First Progress Report of the Territorial Planning Board, 1939, p. 126.

mate of total surface water resources or water consumption.[10]

Measured and estimated diversion in 1946 represented only a small amount of the total surface water used on Oahu. The Honolulu Board of Water Supply diversions are from high-level springs and this water is piped into the city water system for domestic use. The other known diversions are primarily for irrigation.[11]

In 1938 it was estimated that 206,000 million gallons, derived both from ground and surface water, were being used for irrigation of sugar cane plantations. On the basis of recorded ground water consumption by the plantations for the same year, it would appear that almost half of the water so used was obtained from surface flow.[12] Reports of current surface and ground water consumption by the two sugar cane plantations believed to be the largest users of surface water among Oahu plantations--the Oahu Sugar Company and the Waialua Agricultural Company--would tend to indicate the relative importance of surface water in 1938 for irrigation of Oahu's sugar cane may be no longer true today.

If a generalization be attempted, it is that Oahu depends on ground water sources for over half of the water it consumes. Most surface water capable of being economically diverted has long since been so utilized. With the possible exception of the Pearl Harbor springs, which are in fact ground water escaping into the ocean, this precludes any plan to develop surface water as a major source of pure water in addition to present resources.

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[10]The Surface Water Engineer for the Division of Hydrography believes several years of field work would be necessary before an estimate could be made. Even if an estimate should be attempted for a particular year by evaluating known flow in the light of average rainfall statistics for the respective years, the result would be inconclusive due to the total absence of records for some areas of Oahu and the fact that diversions may have changed since the date of the last gauging station record.

[11]See Appendix G and H.

[12]Irrigation estimate from First Progress Report of the Territorial Planning Board, 1939; Plate 57, p. 129.

This of course does not negative the fact that on Oahu there may actually be some surface waters that are now being wasted, but inconsistency of flow, distance from source to place of use, difficulties arising from the storage and filtration of flood flow, and sheer cost of capturing such waters probably precludes extensive use being made of them.

3. Ground Water Law in the Western States

The 17 western states all share at least one characteristic in common with the Territory of Hawaii--a relative scarcity of water which at times demands almost herculean efforts to permit its maximum beneficial use. This insufficiency of water resources has given rise to attempts at piecemeal solutions on the part of the courts and legislatures of each jurisdiction, with the result of developing a somewhat heterogeneous body of water law. Nevertheless, as the same problem is common to all, the results reached, or at least sought, appear to be similar. Despite semantic difficulties it is possible to compare the law of the various states, both as found in the case books and as declared by statute.

Our present interest in the water law of the western states is limited to their treatment of ground water. In some cases, however, this policy is unintelligible unless the concepts of water rights employed are first understood. Because of this, a discussion of the various doctrines established for determining surface water rights is material.

> The western law of water rights embraces the common-law doctrine of riparian rights and the statutory doctrine of prior appropriation. The principles underlying these two doctrines are diametrically opposed to each other, the former being based on the ownership of land contiguous to a stream, without regard to the time of use or to any actual use at all, and the latter on the time of use and an actual use without regard to the ownership of land contiguous to the watercourse.... Under the strict riparian doctrine, the owner of riparian land is entitled to have

the stream flow by or through his land undiminished in quantity and unpolluted in quality except that any riparian proprietor may make whatever use of the water he requires for domestic and household purposes and the watering of farm animals. The doctrine has been generally modified to allow each proprietor to make such use of the water for irrigation of his riparian land as is reasonable in relation to the similar requirements of other proprietors of land riparian to the same stream....

... Under the riparian doctrine, lands contiguous to water courses have the prior claim to the waters of the stream solely by reason of location and regardless of the relative productive capacities of riparian and non-riparian lands. It was thus unsuited to the conditions of the West. A doctrine which laid greater emphasis upon beneficial use and which afforded protection to enterprises based upon the feasibility of directing waters and applying them to lands whether or not contiguous to watercourses was needed. The doctrine of prior appropriation met this need to a very much greater extent....

... The gold miners of California developed a rule with respect to a possessory right to mining claims, giving the first locator of a claim a right to it superior against all later claims. The same rule came to be applied to appropriations of water for the purpose of working the mining claim. The first in point of time to put the water to a beneficial use, without limitation of the place of use to riparian land, came to be recognized as the first in right.... The custom of miners became law through the sanction of court decisions.../and was adapted to diversions of water for irrigation and other purposes/.[13]

The appropriation doctrine has been adopted in all 17 of the arid and semiarid western states. Some of these states also recognize the riparian doctrine concurrently, but in such modified form as to make the riparian doctrine no longer the paramount rule of western law. The United States Supreme Court has repeatedly recognized the right of each state to adopt its own system of water law, whether or not public lands are involved.[14]

The appropriation right is a limited one, that is, the right to water includes only a fixed amount of water within a previously ascertained period,

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[13] State Water Law in the Development of the West, Report to the Water Resources Committee of the National Resources Planning Board by the Subcommittee on State Water Law (July, 1943), pp. 5-7.

[14] Hutchins, Wells A. Selected Problems in the Law of Water Rights in the West. U.S. Department of Agriculture Misc.Pub. No. 418 (1942), p. 34.

at a specified place of diversion, restricted to use for the purpose the water is to be appropriated, and only at the place where it is to be put to that use. Finally, the right occupies a relative place in priority of time, being inferior to previous appropriation rights and superior to later ones.

The law of ground waters in the 17 western states has developed much more slowly than that of surface waters, accretions being due mainly to judicial decision. It seems well settled in these states that clearly defined, subterranean streams are subject to the same rules of law which are applicable to surface streams.[15] Thus, the doctrines of riparian rights, appropriation rights, and their myriad modifications, will apply to these sub-surface streams.

Other underground waters must be considered separately, for three general doctrines have been applied to them: (a) the so-called common-law doctrine of absolute ownership by the owner of overlying land; (b) the doctrine of reasonable use, with its further refinement of correlative use; and (c) the appropriation doctrine.[16] As the rule of reasonable use of underground waters is somewhat analogous to the riparian doctrine with regard to surface waters, one might expect to find the reasonable use doctrine applied to underground percolating waters in those jurisdictions where the riparian prevails, and abrogated in those states observing other doctrines. Actually, this logical consistency is not always encountered. Likewise, there is no necessary correlation found between the doctrines of law applied to the various forms of underground water.

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[15] State Water Law in the Development of the West, op. cit., p. 71.

[16] In the discussion of water law in the Territory of Hawaii found on pages 23-30, infra, reference is made to two of these doctrines, the Supreme Court of Hawaii referring to three principles but treating the concept of correlative use as a separate doctrine and ignoring the appropriation doctrine.

With this background of water law in mind, it is possible to classify the ground water law of the 17 western states, if broad general classifications are utilized:

SUMMARY OF DOCTRINES GOVERNING OWNERSHIP AND USE OF GROUND WATERS IN THE WESTERN STATES[17]

	Subterranean Streams	Percolating Waters	Artesian Waters
Arizona	Appropriation*	(a) (c)	(a) (c)
California	Riparian; appropriation*	Reasonable use (Correlative rights)	Reasonable use (Correlative rights)
Colorado	Appropriation	Appropriation[d]	(b)
Idaho	Appropriation*	Appropriation*	Appropriation*[e]
Kansas	Riparian; appropriation*	Appropriation*	Appropriation*[e]
Montana	Appropriation[f]	Absolute ownership	----------
Nebraska	Appropriation; probably riparian[a]	Reasonable use	(b)
Nevada	Appropriation*	Appropriation*[g]	Appropriation*[e]
New Mexico	Appropriation*	Appropriation*[h]	Appropriation*[e]
North Dakota	Riparian*; probably appropriation[a]	Absolute ownership*	(e)
Oklahoma	Riparian*; probably appropriation[a]	Reasonable use[i]	----------
Oregon (eastern)	Riparian[j]; appropriation*	Appropriation*[h]	Appropriation*[b]
Oregon (western)	Law of surface water courses (riparian[j]; appropriation)	Absolute ownership	(b)

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[17]Based upon Hutchins, Wells A. Selected Problems in the Law of Water Rights in the West. U. S. Department of Agriculture Misc. Pub. No. 418 (1942), pp. 182-265. The above summary was corrected by Mr. Hutchins in November, 1947, to incorporate changes made since the publication of his monograph, and the 1948 Arizona amendments are also included (Ch. 5, Sixth Special Session of 1948).

	Subterranean Streams	Percolating Waters	Artesian Waters
South Dakota	Riparian*; probably appropriation[a]	Absolute ownership*	Reasonable use[e]
Texas	Riparian[k]; appropriation[l]	Absolute ownership	(e)
Utah	Appropriation*	Appropriation*	Appropriation*[e]
Washington	Riparian; appropriation*	Appropriation*[g,m]	Appropriation*[e]
Wyoming	Appropriation[a]	Absolute ownership	----------

*Statute exists.
a Law unsettled.
b Waste from wells prohibited by statute.
c In critical ground water areas may prevent drilling of new irrigation wells. Waste of ground water is prohibited.
d If tributary to streams; if not naturally tributary to streams, probably appropriation.
e Regulated by State officials under statute; includes prohibition of waste.
f Statute includes any natural source of supply.
g Minor exemptions.
h Underground water having no reasonably ascertainable boundaries presumably under absolute ownership doctrine.
i Statute adopts Absolute Ownership, but court decision has modified to Reasonable Use.
j Riparian concept practically a legal fiction.
k Underflow of streams.
l Statute includes underflow of streams.
m Ground water bodies with reasonably ascertainable existence or boundaries.

Many of the western states by statutory or constitutional provisions dedicate waters to the public for the purpose of laying the legal foundation for their appropriation and use under state regulation. Such dedication of water is subject to vested private rights, as well as to the rights of the federal government. In Appendix I are contained condensations of the pertinent portions of the laws of 12 western states which have adopted a dedication to the public of ground waters either expressly or by implication.

Six states[18]--Kansas, Nevada, New Mexico, Oregon (eastern portion of state), Utah, and Washington--have provided administrative procedures governing the appropriation of ground waters from determinable sources. In these states the state administrator has authority to ascertain whether there is unappropriated water in an area where development is proposed. Granting an application to appropriate ground water is contingent upon the existence of unappropriated water in the proposed source. Existing rights are recognized, and safeguards in the form of procedural provisions for hearings and appeal to the courts are contained in each of the acts. They also establish administrative machinery for protecting the water supply by preventing waste and enforcing observance of the terms of the appropriation permit. Appendix B contains drafts of ground water statutes suggested for adoption in all of the western states which encompass these various provisions.

4. The Hawaiian System of Ground Water Rights[19]

Very few cases dealing with rights to the use of ground water have reached the Supreme Court of Hawaii. The decisions which have been rendered treat separately ground waters (1) flowing in defined streams, (2) not in defined streams, and (3) under artesian pressure. Individually or collectively, they do not establish a complete framework of law for determining the rights and liabilities of overlying land owners or attaching to the use of such waters. At best, they permit the generalization that the same principles

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[18] Ibid, p. 176, as modified in November, 1947, by Mr. Hutchins.

[19] This portion of the report is based upon, and in part is a condensation of Hutchins, Wells A. The Hawaiian System of Water Rights (1946).

of law apparently do not apply to each of the three forms of water which have been the subject of adjudication. As yet, the court has not had occasion to consider the interrelation of all forms of ground water, and there has been no opportunity to present the case for an integrated body of adjudicated water law.

Definite underground streams:

The view of the Hawaii Supreme Court appears to be that the rules of law that govern uses of water of definite underground streams are not the same that apply to other ground water. It would also appear that one who asserts a right in a definite underground stream has the burden of proving its existence. Finally, it seems to be the view of the court that "rights" may attach to waters proved to be flowing in known and ascertained subterranean channels; what such rights may be have not been established, for such proved waters have not been in litigation. All of these statements must be phrased in qualified terms for they are dicta, that is, were expressed or intimated by the court, but were not necessary to the decision rendered; as a result, they are only indicative of the Supreme Court's views, but are not binding on the members of the court which is first called upon to decide a case in which they are material.

The principle that rights to underground streams are governed by the same rules of law that pertain to surface streams is well established on the mainland. The strong intimation in the decisions of the Supreme Court of Hawaii is that the holders of established rights to the waters of springs fed by definite underground streams are entitled to the uninterrupted flow of such tributary streams to the same extent as would be the case if the underground streams were on the surface. There appears to be nothing in ancient

Hawaiian law or custom which would mitigate against the full extension of this reasoning, when the court is called upon to adjudicate rights in definite underground streams, nor prevent the application of the rules relating to the use of water from surface streams to their counterpart flowing underground.

Percolating waters:

In the four cases in the Supreme Court of Hawaii which have dealt with this category of underground water, the court questioned the legal possibility of acquiring "rights" in such water. For example, in Davis v. Afong (1884) 5 Haw. 216, at page 223, the court quoted principles to the effect that the rules of law applying to subterranean percolating waters are not the same as those that govern surface and ground waters in known stream channels, and apparently approved of the doctrine that "rights cannot be acquired in subterranean, unknown, percolating water." In Wong Leong v. Irwin (1896) 10 Haw. 265, at page 270, the court referred with approval to the principle that "subterranean waters, to be the subject of rights, must, like surface waters, in general flow in known and well defined channels."

Many developments of ground water in Hawaii have been made by means of tunnels constructed to tap perched water supplies or to collect percolating water. Yet apparently the only Supreme Court decision in which the right of use of such tunnel water has been involved is Hawaiian Commercial & Sugar Company v. Wailuku Sugar Company (1904) 15 Haw. 675, and in that case there was no controversy over the water developed by the tunnel. According to the court it was "undisputed and clear" that the water was the property of the company which had developed it, that is, presumably, not disputed by the other party to the litigation.

None of the principles suggested in these early decisions have been specifically repudiated by the Supreme Court with respect to non-artesian waters. However, its treatment of the cases in a much later decision involving artesian waters tends to cast doubt upon the present applicability of the principles stated. Summing up these four[20] early decisions alone, it appears that (1) no one of them actually adjudicated rights in non-artesian waters as between owners of land overlying a common body of such water; (2) none of them actually adopted any particular doctrine with respect to the use of non-artesian waters; (3) the two earliest ones questioned the possibility of vesting of "rights" in such waters; (4) the purport of three of the cases is to the effect that ground waters are not legally tributary to springs unless proved to be flowing thereto in defined channels.

Artesian waters:

The Supreme Court of Hawaii has had one occasion to pass upon the fundamental nature of the right of ownership and use of artesian water. In the case of City Mill Company v. Honolulu Sewer & Water Commission (1929) 30 Haw. 912, the court held that the Territory is not the owner of artesian water, but that property rights in such waters have vested in common in the owners of land overlying the artesian basin. The rights of such co-owners as against each other were not considered in detail. However, the court did state in effect that all such co-owners in a given artesian area have "correlative" rights in the common body of artesian water, that each one is entitled to a reasonable use of the water with due regard to the similar rights of his co-owners, and is limited to a reasonable share of the water in time

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[20]The fourth decision was Palolo Land and Water Co. v. Territory of Hawaii (1906) 18 Haw. 30.

of actual or threatened shortage of the water or deterioration in its quality, and that "a diversion of water to lands other than that of origin might, perhaps, be permitted under some circumstances and not under others and certain larger uses, as for industrial purposes, might, perhaps, not be permitted on even the land of origin under some circumstances while being permitted under others."

This case is particularly important as it came to the Supreme Court on appeal from a ruling by the Honolulu Sewer and Water Commission denying an application for a permit to drill a new artesian well, the water of which was to be used in buildings of the City Mill Company adjacent to the well site. The situation would be analogous to a denial of an application for a permit under the proposed Oahu Ground Water Control Act. The court ruled that although the police power of the Territory extends to the prescribing of reasonable regulations governing the installation and maintenance of private artesian wells, it did not extend to prohibiting the drilling of a new well while permitting others to continue the operation and use of their existing wells without diminution. The attempt to deprive a co-owner of the waters of the artesian basin without due compensation was held violative of the United States Constitution.

The City Mill Company case is also important for another rule of water law which it contains, even though it is dictum. The Court stated the so-called common law doctrine of absolute ownership of ground waters is unsound, particularly as applied to artesian waters. Davis v. Afong and Wong Leong v. Irwin (supra) are differentiated on their facts for they did not relate to artesian waters. After reviewing three different doctrines followed on the mainland--the "common law doctrine" of absolute ownership; the "reasonable use doctrine" restricting the use of water to what is considered reasonable

but permitting use of all waters obtained; and the "correlative doctrine," a further refinement of the doctrine of reasonable use with an apportionment of the common waters between landowners in event of shortage--it specifically adopted the latter as the rule applying to artesian waters.[21]

Governmental regulation:

At present provision is made by statute for the regulation of artesian wells both inside and outside the City of Honolulu. Regulatory controls are exercised by the Honolulu Board of Water Supply within the City, while the Superintendent of Hydrography administers the provisions for rural Oahu.

The general statute for the whole Territory (sections 4651-4660, Revised Laws of Hawaii 1945) defines "artesian well" and "waste," declares an artesian well not properly equipped and controlled to be a common nuisance, and makes a person responsible for such nuisance or for the waste of artesian water guilty of a misdemeanor. This appears to apply with equal effect to all parts of Oahu.

In rural Oahu the operation and maintenance of artesian wells are subject to regulation by the Superintendent of Hydrography. Operation is not curtailed so long as the well is kept in proper repair, and so long as no waste occurs and the water is used within limits found to be necessary for certain beneficial purposes. Access to wells must be provided at all times for the purposes of inspection. While written notice must be given to the Superintendent before a well may be drilled, the statute does not require obtaining a permit for the drilling.

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[21]Note that this did not include a review of the "appropriation doctrine" which now governs the use of ground waters in many western states (see supra, at p. 20).

The regulatory powers of the Honolulu Board of Water Supply (sections 6865-6875, Revised Laws of Hawaii 1945) are greater than those vested in the Superintendent of Hydrography for rural Oahu. In addition to the prevention of waste and the restriction of the uses of water within beneficial limits, in periods of actual or threatened shortage of water or of danger to its potability, the Board may restrict the withdrawal of water from all wells supplied from an artesian basin on a basis proportionate to the proper and beneficial uses that they respectively serve. The Board also has considerable authority over the installation of new wells and the reopening of old wells within the City. A permit must be obtained before any such new installation or reopening and compliance must be had with the Board's rules relating to the manner which the work is to be accomplished. The posting of a bond may be made a prerequisite to commencement to operations. There is no present authority to deny this permit so long as the applicant complies with these requirements, but the permit may be suspended or revoked if, after a hearing, it is found the well is being improperly maintained or the water is being improperly used. The Board also has the right of access to wells for the purpose of inspection.

Conclusions:

From the cases referred to, it is clear that in Hawaii there are property rights in artesian waters. Waters flowing in definite underground streams have been differentiated and apparently are considered subject to other rules of law--just what they are has not been fully stated. As to other forms of ground water, the Supreme Court of Hawaii has stated in early cases that rights do not attach to "percolating" waters. Literally, this denies the existence of any right, which is a negative way of recognizing the so-called

"common law doctrine" which gives absolute control to the person who succeeds in capturing the water in the substrata of his land but denies to him the right of having that water flow to his land from some other owner's land. In view of the criticism of this doctrine by the Hawaii Supreme Court in the City Mill Company case (applying to artesian water) it is questionable whether the court would adopt the dicta of the early cases and apply the "common law doctrine" of absolute ownership either to percolating water or to other non-artesian waters not in a well defined channel. What system of rights it would recognize is problematical.

5. Oahu Ground Water Control Act

As introduced in both the Territorial Senate (S.B. No. 200) and the House of Representatives (H.B. No. 418) in 1947, the proposed Oahu Ground Water Control Act provides for the regulation of all ground water usage on the Island of Oahu. Exempting only shallow wells with small pumpage for domestic purposes from most of the control provisions, it includes both civilian as well as military ground water consumption. Because of the latter, it is not to become effective until approved by Congress. The provisions of the Act are discussed in detail in Appendix A, which contains a section-by-section analysis.

In general, the Act is designed:

(i) to prevent waste and pollution of ground water and to insure that both use and methods of withdrawal are reasonable;

(ii) to ascertain the nature of all existing ground water rights and to require prior approval for all future ground water development through necessity of obtaining a permit which can be

denied if there is not sufficient water, the permanence and quality of the ground water supply will be impaired, or if other requirements of the Act are not observed;

(iii) to establish a system of priorities for restricting ground water withdrawals during periods when water is inadequate or the permanence or quality of the ground water supply is endangered.

A five-member commission, with staggered five-year terms, would be appointed by the Governor, subject to the consent of the Senate. The Commission is vested with jurisdiction over the withdrawal and use of ground water on Oahu, and succeeds to the powers of the Superintendent of Hydrography and the Honolulu Board of Water Supply with regard to the keeping of records and the prevention of waste and pollution. It is empowered to hold hearings, adopt rules, fix fees, employ persons subject to civil service, require reports of well owners and well drillers, and to effectuate the provisions of the Act. The methods and procedures of the Commission are outlined and provision is made for appealing its decisions and orders to the courts.

All ground waters on Oahu are declared to be public waters, subject to existing valid rights of use. Valid rights exist if water is being used, if it has been used within ten years of the Act's effective date and is again used within a reasonable time thereafter, or if water is used within a reasonable time from development works under construction when the Act takes affect. Apparently no valid right can exist if the water is not used or to be used for reasonable and beneficial purposes. Existing valid ground water rights will be registered, and all are assigned an equal and the highest priority.

The development of new sources of ground water, or the withdrawal of

water in excess of amounts included in existing valid rights, will be possible only if application is made to the Commission and a permit is issued. Such a permit will be granted if the Commission finds there is sufficient water, the permanence and quality of the ground water will not be impaired, and the other requirements of the Act will be met. Between conflicting applications, preference is to be given, first, to war-time military uses; second, to domestic, municipal and comparable peace-time military uses; third, to agricultural uses; fourth, to industrial and manufacturing uses; and lastly, to all others. Priority for the use of water obtained through permit is determined by the date of the permit, the first in time having the highest priority.

Provision is made for the establishment of ground water areas and sub-areas, and for the adjudication by the courts of water rights in these areas. Water rights, including rights under permit, may be transferred in the manner recognized, and provision is made for their forfeiture and abandonment.

After hearing and upon a finding that there is an inadequate amount of water in a water area or sub-area, or that the permanence or quality of the ground water supply is endangered, the Commission may restrict withdrawals of water. Rehearings may be required yearly. Restrictions will be imposed in reverse order of priority of rights, and will apply proportionately to all rights with the same date of priority. Thus complete stoppage may be ordered as to persons obtaining water by permit, depending on their order of priority, but all withdrawals of persons having valid rights to use ground water at the time the Act becomes effective may only be proportionately reduced and this only after all withdrawals under permit have been stopped. Provision is also made for disregarding priority of right if a supplemental water supply is furnished, if adequate compensation is made, or if the holder of the prior

right consents.

Temporary cessation of withdrawals from a particular well may be ordered for not exceeding two years, if the Commission finds the permanence, quality or maximum usefulness of the ground water supply is adversely affected by the well. A substitute supply of water must be furnished at no increase of net cost to the well owner in the obtaining of water. If the continued existence of the well is a menace to the ground water resources, or if the substitute supply of water cannot be furnished, the well may be condemned and sealed. The extra cost incurred in making the substitute supply of water available, and the compensation and damages to be paid as a result of condemnation proceedings are to be met only out of funds which the legislature will be asked to appropriate separately.

Constitutionality:

It will be noted that the basis of the change made by the Oahu Ground Water Control Act is the declaration that all ground water is public property, which has been similarly done in a number of the western states (see Appendix I). Thus, as no one has a property right in ground water, he merely has the right to the use of ground water, and this right to use is determined by actual, beneficial user rather than by the fact one happens to own surface lands that are located over a source of ground water. This is directly contrary to the ruling in the City Mill Company case (see discussion on pages 26 to 27, supra) for in that case the Supreme Court of Hawaii held the Territory is not the owner of artesian water, but that it is owned in common by the owners of land overlying the artesian basin. Should the Court adhere to this ruling, part, at least, of the Oahu Ground Water Control Act would be unconstitutional.

The City Mill Company decision may possibly be distinguished as

inapplicable to the proposed Oahu Ground Water Control Act on the ground that there was no emergency existent at the time. In the Oahu Ground Water Control Act, section 4 contains a legislative declaration of emergency. The legislative act pursuant to which the Honolulu Sewer and Water Commission acted in denying a permit to drill a well (Session Laws of Hawaii 1927, Act 222) included no finding nor declaration that an emergency existed, and the record did not show one. However, the court did indicate in dictum that irrespective of the existence of a supposed emergency, private water rights cannot be confiscated for community use in time of peace. To do so, the United States Constitution requires the community to pay for the private property taken.

Actually, the facts today do not bear out the existence of an acute emergency on Oahu, nor does section 4 declare it. The point of general depletion of ground water resources beyond which some system of curtailment of necessity must be practiced has been postponed, although in 1945 it appeared more imminent due to the increased rate of consumption of ground water. All the facts bear out is that an acute emergency may develop in particular ground water areas because of over-pumping, and for some areas, the intrusion of salt which has already occurred tends to indicate that this time may not be far off unless pumpage is kept within normal bounds. In the past Oahu has tended to draw on the reserve of ground water in artesian areas built up over the centuries; future reliance must be placed on current recharge rather than stored surplus. That Oahu, and the City of Honolulu in particular, may be tending toward a general situation of insufficient water if consumption again rises as it did by 1945 does not itself indicate an emergency now exists. In other words, all that section 4 of the Oahu Ground Water Control Act indicates and all that the facts bear out is the existence of a condition which in analogous situations in a number of states has been considered sufficient

to support the adoption of statutes, in principle similar to the Oahu Ground Water Control Act, under the state police power when their legislatures considered it advisable to enact such legislation to protect and preserve one of their fundamental resources--water.

Fundamentally, the constitutionality of the statute would thus appear to turn on whether the concepts of property rights with relation to water are different in the Territory under the Fifth Amendment than in the states under the Fourteenth Amendment. Both amendments protect private property, yet some of the states by state constitutional provision or by statute have adopted the rule of appropriation, with prior state approval being a requisite to the obtaining of water, thus replacing other doctrines of water rights. As stated by Thompson and Fiedler:

> The Supreme Court of the United States has given a number of decisions which have interpreted the 14th Amendment in such way as to give reasonable hope that it would not look upon the abandonment of the doctrine of riparian rights as the taking of property without due process of law, and has specifically recognized the power of the states to change the doctrine of riparian rights to the doctrine of appropriation.[22]

It is difficult to square the conclusion of the City Mill Company case that there was a taking of property under the territorial statute in violation of the United States Constitution with similar regulation apparently permitted under state statutes not considered as violating the property guaranties in the United States Constitution.

In the absence of a decision on the constitutionality of the proposed Oahu Ground Water Control Act, the rule of the City Mill Company case with

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[22]Thompson, David G. and Fiedler, Albert G. "Some Problems Relating to Legal Control of Use of Ground Water." Journal of the American Water Works Association (1938), Vol. 30, No. 7, p. 1049, quoted in Black, A. P. "Basic Concepts in Ground Water Law." Idem (1947) Vol. 39, No. 10, p. 996. See also, note 14, supra, at page 19.

relation to artesian water does not necessarily preclude the holding constitutional of parts of the Act, or its application to other forms of ground water. The City Mill Company decision did not establish limitations on territorial powers with regard to water flowing in well defined channels and to percolating waters. As the Act contains a "separability" clause (section 25), even if the provisions purporting to change the correlative rights doctrine with regard to artesian water are held unconstitutional, the same control provisions may be valid as to the other forms of ground water. Similarly, as a result of the "separability" clause, the provisions of the Act which are concerned with the keeping of records and the prevention of waste and pollution may be sustained since the court has previously held this type of regulation to be within the police power of the Territory and the Territory now enforces somewhat similar requirements. However, it should be pointed out that the legal distinctions between the three forms of ground water arose when the courts did not have access to the scientific facts and observations now available. With correct interpretations of natural laws and with observed hydrologic data before it, the Supreme Court of Hawaii may refuse to follow legal precedent, and reach a different conclusion, adopting the hydrologist's concept of the inter-relation of all ground water and eliminating the ground water classifications known to the law. This may result in applying the rule of the City Mill Company case to all forms of ground water--but just as logically may permit the court to disregard it completely and consider the Act as presenting a question of law arising for the first time in the Territory to be decided anew on its merits.

To further elaborate on the constitutionality of the Oahu Ground Water Control Act is fruitless. Suffice it to conclude that in light of one decision of the Supreme Court of Hawaii its constitutionality, at least in part,

is questionable, but that is not to say it is clearly unconstitutional. Somewhat comparable factual situations have been considered sufficient to justify ground water regulation in the states similar in principle to that proposed in the Oahu Ground Water Control Act.

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APPENDIX A.

ANALYSIS OF PROVISIONS OF THE PROPOSED OAHU GROUND-WATER CONTROL ACT
(S.B. No. 200 of 1947; H.B. No. 418 of 1947)

SECTION 1. Definition of Terms: Defines ground water, water table, artesian water, artesian head, well, well driller, domestic use, municipal use, municipal water supply, and agricultural use of water. No definition is contained for "industrial use" or "commercial use" of water. "Agricultural use" is defined to include only irrigation of land for the production of crops, other than lawns and not more than ½ acre gardens. "Domestic use" includes watering of stock used for operating a farm, or to be utilized for family food, but inferentially excludes stock and dairy operations. "Domestic use" is also defined so as to encompass servicing the ordinary amenities of life. "Municipal use" expressly incorporates domestic use, but probably does not include commercial use, industrial use, agricultural use, etc., within the community unless they can be shown to be for the promotion of the health, comfort or safety of the inhabitants.* "Well" is any artificial opening into the ground by means of which ground water can be obtained, and includes a spring if its natural opening is artificially enlarged to permit the withdrawing of water.

SECTION 2. Application of Act: Applies only to Oahu. In addition, it will apply only if the act is approved by the Congress of the United States as a result of Section 29.

SECTION 3. Exemptions: Small wells, i.e., wells less than fifty feet in depth, which draw less than 10,000 gallons per day, are exempted from some of the control provisions. Waste and pollution are prohibited, reports may be required for these wells, and if the well owner desires to have his rights adjudicated, he waives the exemption.

SECTION 4. Declaration of emergency: Reciting the increasing need for water, the declining of water tables, and the danger of salt encroachment, the Act declares public control is required to prevent further depletion in supply and deterioration in quality.

Highest use for water is for military purposes during war time; next highest use is for domestic, municipal, and comparable peace-time military purposes; third highest is for agricultural pursuits. Presumably commercial use, mill use, stock raising, etc., are in lower categories.

Apparently this recital of superiority of uses of water has application only to preference between conflicting applications for permits (see Section 13) and not to orders restricting withdrawals of water from wells during emer-

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*This result is reached because of section 13 (b) which recognizes the different uses and gives "municipal use" a priority over "commercial use," etc., in applications for permits to withdraw water.

gencies (see Section 14) which will be determined in the reverse order of priority of rights.

SECTION 5. Public ownership and control of ground waters: All ground waters are declared to be public property, but are subject to existing valid rights of use. Ground water in excess of that required for valid existing rights is subject to withdrawal under new rights of use acquired by permit pursuant to the Act. However, even the exercise of existing rights of use must conform to the Act.

SECTION 6. Rights to withdraw and use ground water: (1) Rights are limited to reasonable use of water and to reasonable methods of withdrawal and use. Use and methods of use are deemed unreasonable if they (a) result in waste, (b) pollute a ground water supply, or (c) exceed "requirements for domestic, municipal, agricultural, industrial and other beneficial purposes as measured by the highest standards of practical application to the locality and the use to be served." Method of withdrawal is deemed unreasonable if (a) it endangers permanence of ground water supply, its quality for drinking or other uses, or impairs its maximum usefulness; (b) availability of adequate quantity of usable water at a particular well, due to its location, requires water level elsewhere to be kept at stage which prevents the greatest possible utilization of the ground water supply. Presumably, what is reasonable in any particular situation will be determined with reference to the hierarchy of uses established by section 4.

(2) Preexisting rights to water are to be recognized only (a) if the water is actually being put to beneficial use when the Act goes into effect in conformance with the policy of the Act and requirements for reasonable use and reasonable methods of use and withdrawal; (b) if the water has been used within ten years of the Act's becoming effective, it is intended to again withdraw and use it, there has been no abandonment of the right, and it is again used within a reasonable time; (c) if works are under construction and use of water is expected to be and is begun within a reasonable time.

(3) All rights in existence have equal priority, their priority dating from the time the Act becomes effective. Rights to withdraw and use water acquired subsequently under permits granted pursuant to section 13 will date from the time of application for the permit (Section 13(11)).

(4) Placing of water in the ground to be recovered at another place allowed under permit and specified safeguards.

SECTION 7. Oahu Ground Water Commission: (1) Creates a five member board, with five year staggered terms, appointed by the Governor subject to Senate confirmation. Only residents of Oahu are eligible.

(2-7) Members' compensation is fixed at $10 per day for each day spent on the business of the Commission. The Commission is empowered to adopt rules, keep records (which are to be public records), employ persons subject to civil service, and sue and be sued in its own name. The Attorney General will be its legal adviser, but the Commission may employ an attorney to act as its legal adviser and to represent it in litigation.

SECTIONS 8 and 9. Jurisdiction of Commission: The Commission is vested with jurisdiction over the withdrawal and use of ground waters on Oahu, and the acquisition and exercise of all rights to withdraw and use such waters. It succeeds to the jurisdiction over artesian wells in Oahu now lodged in the Superintendent of Hydrography and over all waters in the Honolulu district now granted to the Board of Water Supply of the City and County of Honolulu.

The Commission is empowered to make studies and investigations, enter upon private property without warrant in the performance of its duties, hold hearings, require installation of equipment to safeguard the ground water supply, require reports of well owners and well drillers, and to effectuate the provisions of the Act discussed more fully elsewhere.

SECTION 10. Statements of withdrawals and uses of waters: Within a period of 6 to 9 months after the Commission calls for statements of existing and proposed withdrawals and uses of water from wells, they must be filed under oath containing the information required by the Act and rules of the Commission. These statements will provide a complete picture of all of the existing wells on Oahu and of current and proposed uses of water from them. In addition, they serve as claims of right to withdraw and use the ground water stated (section 12, subdivision 4). Drilling new wells or withdrawing and using additional water thereafter will be authorized only by Commission permit (section 13).

SECTION 11. Ground water areas and sub-areas: After the period for filing statements has expired, the Commission for administrative purposes may establish ground water areas or sub-areas after holding a hearing, and may similarly change their boundaries or abolish them. Each ground water area will consist of a distinct supply of ground water, all of whose parts are found to be interconnected. A sub-area will cover a portion of a ground water area having different characteristics which indicate the advisability of separate administrative treatment. Unless judicially approved, a change of boundaries may not be made after rights to the use of ground water have been adjudicated if the adjudicated well will be placed in another area.

SECTION 12. Adjudication of rights to use of ground water: After a ground water area is created, the rights to withdraw and use ground waters from wells in the area may be adjudicated on the Commission's applying to the Circuit Court in Honolulu. In addition, the rights to surface waters originating in the area may be adjudicated in the same proceeding if the Commission believes it advisable. Persons not named as parties but claiming an interest may intervene in the action and have their rights adjudged; if they fail to do so, and within three years after the issuance of the decree fail to show good reason for not intervening, their rights will be barred.

The existing law relating to the determination of controversies over private ways and water rights will be followed, in so far as practicable, except that the judge must refer the controversy to the Commission before announcing his determination. The Commission will make investigations, hold hearings, take testimony, and submit a report to the judge containing its findings and a proposed adjudication. All judicial determinations of ground water rights in the area in controversy are suspended while the Commission is investigating

and preparing its report. The final decree will be based upon the Commission's report and new evidence introduced by parties filing exceptions. Adjudications of water rights will be in conformity with the provisions of the Act previously discussed declaring all ground water is public property and qualifying the exercise of rights to withdraw and use it. The Act requires the decree to contain specific details as to rights to each well. Appeal to the Supreme Court may be taken by an aggrieved party.

With the exception of small wells exempted from the Act, after the decree becomes effective it is unlawful to withdraw or use ground water in the area if not in conformance with the provisions of the adjudication or a permit issued by the Commission.

SECTION 13. Permits for wells. In order to use more water from wells than is allowed under existing rights, to resume the use of unused wells, or to drill new wells a permit from the Commission is required. Hearings will be held on applications, with interested persons having the right to present objections. The application will be granted if the Commission finds there is sufficient water, the permanence and quality of the ground water supply will not be impaired, and the other requirements of the Act will be met. Proposed work must be performed so as to comply with the Act and the Commission's conditions.

Between conflicting applications, preference is to be given: 1st, wartime military uses; 2nd, domestic, municipal and comparable peace-time military uses; 3rd, agricultural uses; 4th, industrial and manufacturing uses; 5th, all others.

Persons using water under permit from wells located in ground water areas which already have been the situs for a court action to adjudicate water rights (under section 12) may apply to the court for a supplemental adjudication of rights.

SECTION 14. Orders restricting withdrawals of water from wells during emergency: Emergency is defined as: (a) inadequacy of area or sub-area ground water supply for needs of all holding rights to withdraw and use its waters, or (b) endangering of permanence or quality of the ground water supply or the impairing of its maximum usefulness resulting from water withdrawals affecting water tables or artesian heads.

The Commission, after hearing, may find an emergency to exist or is impending, and may restrict withdrawals of water. Such restrictions are to be imposed in the reverse order of priority of rights, and are to apply proportionately to all rights with the same date of priority. Priority of rights may be disregarded if written consent is given by the holders of the superior rights; if adequate compensation is made; or if a supplemental supply of water, equivalent to the amount which would be received if priorities were observed, is furnished. After one year, upon petition, the Commission must hold a hearing to determine whether restrictions may be modified or removed.

SECTION 15. Cessation of withdrawals from particular wells: The Commission may stop all withdrawals from a well having priority of right if it finds the continued withdrawal will adversely affect the permanence, quality

or maximum usefulness of the ground water supply of an area or sub-area. Either a substitute supply of water must be furnished or the well condemned and sealed. If a shutdown is ordered, the period cannot exceed two years.

A substitute supply must be no less useful than the water ordered shut off, and its cost to the person receiving it must not exceed the reasonable expense the person would incur in obtaining the original supply. The difference between the reasonable expense figure and the actual cost of the substitute supply, if any, may be paid by the Commission out of special funds appropriated by the Legislature or contributed from other sources.

SECTION 16. Condemnation and sealing of wells: If the Commission finds that a substitute supply of water cannot be furnished under section 15, or that the continued existence of a well is a menace to the safety or maximum usefulness of a ground water supply, it may institute proceedings to condemn the well. Damages will be paid only out of funds specially appropriated for the purpose. If a substitute supply will be furnished in perpetuity, damages to be paid will not exceed the difference between the reasonable expense incurred for the original supply and the cost of the substitute supply.

An owner of a well may relieve himself of all future liability arising from any well by surrendering it to the Commission. The latter must accept responsibility for it and seal it permanently.

SECTION 17. Appurtenances and transfers of rights: The right to withdraw or to use water is appurtenant to the well from which the water is drawn and to the land on which the water is used. The right passes with a conveyance of the well or the land, but may be transferred separately. Upon permanent changes being made, and upon substituting wells from which the right to withdraw water applies or lands on which the water is to be used, the right becomes appurtenant to the substituted well or land, if the provisions of section 18 are observed.

SECTION 18. Changes in wells, place of use, and purposes of use of water: Permanent changes may be made after hearing and finding that no injury will result to the ground water supply of the area or to persons with rights to wells or water in the area. Temporary changes (less than a year) may be made after similar finding but without the necessity of hearing.

SECTION 19. Forfeiture and abandonment of rights: The holder of a right to water who voluntarily fails to exercise it for ten consecutive years after the Act becomes effective is conclusively presumed to intend to abandon his right. Abandonment and forfeiture may also occur without regard to the ten-year period if actual intent to abandon is accompanied by cessation of exercising the right. Forfeiture can be declared only by decree of the Circuit Court in Honolulu. Upon the rendering of the decision, the water covered by the forfeited right becomes available for the use of other holders of rights in the order of their respective priorities.

SECTION 20. Appeal to court: Any person aggrieved by any decision or order of the Commission may appeal to the Circuit Court in Honolulu. Appeal may be carried to the Supreme Court from the decision of the Circuit Court judge. In the Circuit Court the judge will determine the form and content of

the record to be certified by the Commission, and equity practice is to govern all appeals.

SECTION 21. Unlawful practices and failure to act: The Commission may order a person to cease violating provisions of the Act or its rules, and may thereafter bring criminal action upon failure to comply with the order. In addition, or in lieu thereof, the Commission may bring an action to enjoin the unlawful practices.

SECTION 22. Penalties: Violations of the Act, rules, and orders, are to be punishable by a fine not exceeding $50 for each offense.

SECTIONS 23 and 27. Receipts and disbursements; appropriations: All moneys received by the Commission are to be covered into a special fund in the territorial treasury and are to be expended for carrying out the provisions of the Act. In addition, $150,000 is appropriated for current expenses.

SECTION 24. Fees: The Commission is required to fix fees for its services, which are not to exceed their reasonable cost.

SECTIONS 25 and 26. Savings clause; repeal of conflicting provisions: In case of determination of partial unconstitutionality, section 25 expresses the legislative intent that the balance of the Act is still effective. Repeals sections 6867-6872 and 6874 relating to the powers of the board of water supply over artesian and other waters, and makes inapplicable to Oahu sections 4654-4656, 4658-4660, and part of 4653 of the Revised Laws of Hawaii 1945 relating to the powers of the superintendent of hydrography.

SECTION 28. Short title: Oahu Ground-Water Control Act.

SECTION 29. Effective date: On approval by Congress.

APPENDIX B

GROUND-WATER STATUTE SUGGESTED BY SUBCOMMITTEE ON STATE WATER LAW, WATER RESOURCES COMMITTEE, NATIONAL RESOURCES PLANNING BOARD*

SECTION 1. The waters of underground streams, channels, artesian basins, reservoirs, lakes and other bodies of water in the ground are defined for the purposes of this act as "ground waters". Subject to existing vested rights of use therein, all such ground waters are hereby declared to be public waters and to be subject to appropriation for beneficial use under the terms of this act and not otherwise. It is the express intention of the Legislature that the procedure provided in this act shall be the exclusive method by which appropriations of ground water hereafter shall be made and that no appropriation of ground water made or title to the use of ground water acquired in any other way shall be recognized as valid. The provisions of (here cite the laws regulating the appropriation and adjudication of rights to surface waters, provided the constitution of the State permits the extension of existing statutes in such manner; otherwise such provisions will need to be quoted in full) insofar as the same are applicable and except as modified herein, shall govern the acquisition, adjudication, and protection of rights to the use of ground waters.

SEC. 2. Beneficial use is the basis, the measure and the limit of the right to the use of the waters described in this act.

SEC. 3. The State engineer shall administer this act and shall have authority to prescribe such rules and regulations, to require such reports from water users, and to make such investigations as he deems necessary for the administration of this act. In conducting investigations or otherwise administering this act, the State engineer shall have authority to cooperate with agencies of the United States, or agencies of this State or of any other State, or any political subdivision of this State, or any public or private corporation, or any association or individual.

SEC. 4. The State engineer from time to time, as the necessity therefor arises, shall designate administrative ground-water areas or subareas, which shall constitute as nearly as possible distinct supplies of ground water; and from time to time he shall designate such modifications of the boundaries of existing areas or subareas as he may deem advisable. Notice of such designations shall be published once a week for three consecutive weeks in a newspaper of general circulation in each county in the area affected. Priorities of rights to the use of ground waters shall be established separately with respect to each such area or subarea which constitutes in fact a separate source of water supply; provided, however, that where ground waters of different areas or subareas are so inter-connected as to constitute in fact one common water supply, or where ground

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*Source: Appendix D, "State Water Law in the Development of the West" Report to the Water Resources Committee of the National Resources Planning Board by the Subcommittee on State Water Law (June 1943) pp. 128-132.

waters and the waters of surface streams are so interconnected as to constitute in fact one common water supply, priorities of rights to the use of all such interconnected waters shall be correlated and such single schedule of priorities shall relate to the whole common water supply.

SEC. 5. No appropriation of ground waters described in this act shall be made, nor shall any wells be drilled or dug nor any tunnels or other methods of diversion be constructed for the purpose of making an appropriation, unless an application to the State engineer for a permit to make such appropriation has been approved and a permit has been granted by him: Provided, however, That users of water from wells for domestic or stock-water purposes, or for the watering of lawns or gardens not exceeding one-half acre in area, are exempt from the provisions of this act, except as to the furnishing of any information required by the State engineer. (Insert details of publications, filing of objections, hearings, and findings; preferably, these procedures should be the same as those applying to applications and permits in the case of surface water appropriations.) Before approving any application for a permit, the State engineer shall determine whether there is any unappropriated ground water in the area or subarea affected, or in the common supply of different areas or subareas if ground waters and the waters of surface streams are so interconnected to constitute such common supply, and he shall issue a permit to appropriate ground waters only if such determination is affirmative: Provided, That in no event shall any permit be granted for the development of ground water in excess of the capacity of the subterranean beds or formation in the area or subarea to yield such water with a reasonable or feasible pumping lift. It shall be an express condition of each appropriation of ground water acquired under this act (1) that the right of the appropriator shall relate to a specified quantity of water which may be obtained with a pumping lift which does not exceed the maximum lift found by the State engineer to be reasonable or feasible at the time of the granting of the permit, and (2) that such right does not include the right to have the water level at the appropriator's point of diversion maintained at any level higher than that necessary to make effective such reasonable or feasible pumping lift; and nothing herein shall be so construed as to prevent the granting of permits to applicants later in time on the ground that the diversions under such proposed later appropriations may cause the water level to be lowered at the point of diversion of a prior appropriator, so long as the rights of holders of existing appropriations can be satisfied under such express condition. No permit to appropriate ground water at a point within any designated area or subarea shall be denied because of the fact that the proposed place of use is outside or partly outside the boundaries of such area or subarea, provided existing rights to the use of water in such ground-water supply would not be impaired by the removal of water under the proposed appropriation outside such boundaries.

SEC. 6. Existing vested rights to the use of waters in the sources stated in section 1 of this act, based upon application of the water to beneficial use, are hereby recognized. Nothing herein contained is intended to impair the same or to disturb the priorities thereof. All claimants of vested rights to the use of ground waters in any designated area or subarea, other than users exempted under the provisions of section 5 hereof, shall file notice of such claims with the State engineer, on forms prescribed by him, within 90 days after the last publication of notice of the designation

of such area or subarea: Provided, That the State engineer, in case of the absence of a claimant at the time of publication of notice of designation or for other good cause shown, may extend for an additional period not exceeding 1 year the time within which such claimant may file such notice of claim. Failure to file such notice of claim of vested right within the time required by this act or as extended hereunder by the State engineer shall terminate such right, and the ground waters to which such claimed right formerly attached shall revert to the public and shall be available for further appropriation, subject to existing priorities. Such notice of claim shall set forth the amount of water applied to beneficial use, the purpose for which the water has been used, the date or approximate date of first application of the water to beneficial use, the continuity of such use, the location of the well or other means of diversion, the place of use and, if the water has been used for irrigation purposes, the description of the land upon which the water has been so used and the name of the owner thereof, and such other information as the State engineer may by regulation require. If the claimant cannot verify the information contained in such notice of his own personal knowledge, he may do so on information and belief. Notice of claims of vested rights to the use of ground waters shall be published in the manner required in section 5 of this act with respect to applications for permits to appropriate water. Such claims shall be recorded in the office of the State engineer and in the office of the county clerk of the county wherein the well or other means of diversion is located. Such records or copies thereof, officially certified, shall be prima facie evidence of the truth of their contents, subject to adjudication of the claimed right in the manner provided by law for the adjudication of rights to the use of waters of streams and other sources. (In the event that the existing statutory procedure relating to the determination or adjudication of surface-water appropriations is deemed inadequate or to require modification or amplification for this purpose, delete everything after "claimed right" in the foregoing sentence and insert details of an adequate procedure for determining or adjudicating rights to the use of ground waters. Depending upon local conditions and State practices and organization, it may be desirable to provide for an immediate adjudication by the courts, or to have the State engineer act as a referee for the court in holding fact-finding hearings, or to have the State engineer himself make a determination, subject to appeal, on the basis of a hearing of objections to claims of vested rights.)

SEC. 7. The State engineer, whenever in his judgment it is necessary, shall appoint for each designated area or subarea one or more ground-water supervisors, who shall supervise the withdrawal of ground waters within such area or subarea under the direction of the State engineer. The terms of employment, compensation, removal, and police authority of such ground-water supervisors shall be the same as provided by law with respect to commissioners or watermasters appointed to supervise the distribution of water from surface streams. (Here cite or set out in full with necessary modifications the appropriate existing laws providing for the organization charged with administration of surface streams and functions thereof. If such laws are not deemed appropriate or adequate, provisions may be made for annual appointment of ground-water supervisors, after consultation with users regarding personnel and finances, their salaries and expenses to be borne pro rata by the users; for creation and enforcement

of liens for failure to pay such pro rata; for removal for cause; and for adequate police powers.)

SEC. 8. The State engineer may hold a hearing at any time on his own motion and shall hold a hearing upon petition of at least 50 or one-fourth, whichever is the lesser number, of the record holders of rights relating to ground waters in any designated area or subarea to determine whether the water supply in such area or subarea is adequate for the needs of all such record holders: Provided, That the term "record holders" as used in this section refers to holders of permits, holders of completed rights of appropriation, and claimants of vested rights, as shown by the records of the State engineer. Public notice of such hearings shall be given in the form and manner deemed most suitable by the State engineer. If the finding is negative, the State engineer shall order that withdrawals of water be restricted to conform to priority rights during the period of shortage.

SEC. 9. Failure for 4 successive years on the part of the holder of any adjudicated or unadjudicated right to the use of ground water, whether such right be initiated after the passage of this act or be claimed as a vested right, to use beneficially all or any part of the ground water for the purpose for which such right shall be acquired or claimed, shall work a forfeiture of the right to the use of such water to the extent of such nonuse: Provided, however, That any such water-right holder or vested-right claimant, in case of nonuse for 4 successive years, may apply to the State engineer for a reasonable extension of time, which shall not exceed 2 additional years and which shall be granted only upon a showing of good cause for such nonuse: And provided, further, That in the event nonuse of water shall be occasioned by an order of the State engineer restricting withdrawals during a period of shortage under the provisions of section 8 of this act, such nonuse during the time such order is in effect shall not work a forfeiture, but in the event of nonuse for a period less than 4 consecutive years immediately preceding the time such order goes into effect and a period of nonuse immediately succeeding the revocation of the order, the sum of such immediately preceding and succeeding periods shall be considered as one continuous period in computing the 4 years of continuous nonuse necessary to work a forfeiture. Upon the forfeiture of a right to the use of ground water, such water shall revert to the public and shall be available for further appropriation, subject to existing priorities. The State engineer shall provide by rule or regulation an appropriate procedure for declaring forfeitures and establishing voluntary abandonments of ground-water rights and claims as matters of public record, such procedure to include provisions for notice, hearing, and appeal.

SEC. 10. The holder of a ground-water right or of a permit to appropriate ground water, or the claimant of a vested right may, without losing priority of right and only upon compliance with the provisions of this section, change the purpose or the place of use of the ground water, or may install wells or other means of diversion at a new location in substitution for or in addition to those at the original location in order to obtain the quantity of water to which his right or permit or claim refers. Such holder or claimant, before making any change of purpose or place of use, or before installing any substitute or additional diversion in a new

location, shall file with the State engineer an application for permission therefor upon a form prescribed by the State engineer. The State engineer shall approve such application only if he finds, upon a showing by the applicant, that the proposal if effected will not enlarge the applicant's right and will not otherwise impair other existing rights: Provided, That no installation of a substitute or additional well or other means of diversion which would withdraw ground water from a new and different source of supply, as indicated by the State engineer's designated ground-water areas or subareas, shall be permitted, unless a new appropriation from the proposed new source of supply shall be made, under the procedure provided in this act, for the use of water at the original place of use in lieu of or to supplement an existing inadequate supply. With respect to all such proposed changes or installations in new locations, there shall be publication of notice, filing of objections, hearings, and findings in the same manner as provided in section 5 of this act in the case of original applications for permits to appropriate water. In granting an application for permission to install a substitute well or other means of diversion of ground water, the State engineer shall order the discontinuance of the original well or other means of diversion; and in granting an application for permission to install an additional well or other means of diversion, he shall place such restrictions upon the use of the combined means of diversion as to prevent the applicant from diverting water in excess of the conditions of his existing right or permit or claim. The State engineer shall require the proper plugging of any well, the use of which has been discontinued, or the proper repair of a well in need of repair, in order to prevent loss of ground water or contamination of the ground-water supply.

SEC. 11. The decision or findings of the State engineer shall be final in all cases, unless appeal by any person aggrieved be taken to the district court within 30 days after such decision has been made or findings issued.

SEC. 12. The State engineer shall, by regulation, prescribe the fees to be paid in advance by applicants for permits to appropriate water, claimants of vested rights, and applicants for permission to change the purpose or place of use of ground water or to install substitute or additional wells or other means of diversion in a new location, but such fees shall not exceed the reasonable cost of the services to be performed by the State engineer. In addition to paying the prescribed fees, such applicants and claimants shall pay for the publication of notices required in sections 5, 6, and 10 of this act in connection with proposed appropriations, claims of vested rights, and proposed changes in purpose or place of use or installation of substitute or additional means of diversion. Before holding a hearing on any application for a permit to appropriate water or application for permission to change the purpose or place of use of ground water or to install substitute or additional wells or other means of diversion in a new location, the State engineer shall require each applicant to deposit with him a sum equal to the estimated cost of the hearing on his application and shall require each protestant to deposit a sum equal to the estimated cost of hearing his protest, and, after the decision, the State engineer shall refund to the prevailing party or parties the sum so deposited by him or them that is unused after pro rata payment of costs. (In the event that procedure is provided for the determination of claimed vested rights after

a hearing by the State engineer of objections to claims, as suggested in parentheses at the end of section 6, insert in the foregoing sentence, after "new location," the words "or claim to a vested right," and after "applicant" the words "or claimant") All fees and other money collected under the provisions of this act shall be deposited with the State treasurer and by him placed in a fund to be known as the "Ground Water Fund," subject to withdrawal by the State engineer, upon vouchers properly audited, for the purpose of making refunds and of otherwise administering this act.

SEC. 13. The sum of ..... is hereby appropriated from the general funds of the State, not otherwise appropriated, to carry out the provisions of this act.

SEC. 14. Any person or corporation who shall violate any provision of this act, shall be guilty of a misdemeanor, and upon conviction thereof, shall be fined not less than $10 nor more than $100 for each offense; and each day's violation shall constitute a separate offense.

UNIFORM UNDERGROUND WATER LAW FOR WESTERN STATES[1]

SECTION 1. The waters of underground streams, channels, artesian basins, reservoirs, lakes, or other bodies of underground water moving in a definite lateral direction, having boundaries scientifically ascertainable, are hereby declared to be public waters and to belong to the public and to be subject to appropriation for beneficial use under the terms of this act and not otherwise. The provisions of (here cite the laws regulating the appropriation and adjudication of rights to surface waters, provided the constitution of the State permits the extension of existing laws by reference to their titles and without quoting the provisions in full[2]) insofar as the same are applicable, and except as modified herein, shall govern the acquisition and protection of rights to underground waters.

SEC. 2. Beneficial use is the basis, the measure and the limit to the right to the use of the waters described in this act.

SEC. 3. The State engineer shall administer this act and shall prescribe all necessary rules and regulations for such administration. The State engineer shall designate administrative underground areas and subareas. His finding shall be published once a week for 3 consecutive weeks in each county in the area affected, and shall be final unless appeal be taken to the district court in the county in which the largest portion of the administrative area or subarea is situated within 30 days after the last publication. Priorities to underground waters shall relate to such area and/or subareas. The State engineer may require periodical statements of water elevations, water used and acreage on which water was used from all holders of permits and claimants of vested rights.

SEC. 4. No appropriation of underground waters described in this act shall be made, and no well shall be drilled or dug or tunnel constructed for such purpose, until application to the State engineer shall have been approved and permit granted by him. (Insert details of publications, filing of objections, hearing, and findings.) The State engineer

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[1]Source: Recommended by Association of Western State Engineers. See pp. 135-136, Appendix F, "State Water Law in the Development of the West." Report to the Water Resources Committee of the National Resources Planning Board by the Subcommittee on State Water Law (June 1943).

[2]For example, the constitution of New Mexico provides that no law shall be revised or amended, or the provisions thereof extended, by reference to its title only; whereas the constitution of Utah provides that no law shall be revised or amended by reference to its title only. Certain legislation in 1933 in Utah extended the provisions of existing law to the statute then being passed, by referring only to the title of the existing law. This matter will have to be determined for each State in which it is desired to include the last sentence of section 1.

shall find as to whether there is unappropriated water in the area affected and shall issue the permit only if such finding is affirmative. Any person aggrieved may appeal to the district court within 30 days after such findings were issued.

SEC. 5. Users of water from small domestic wells, as the State engineer shall define them, are exempted from the provisions of this act except as to the furnishing of any information required by the State engineer.

SEC. 6. Vested rights shall not be interfered with and all existing vested rights are hereby confirmed. Use of a certain measure of underground water from a certain outlet, for beneficial and economical application to certain described land, or for a certain industrial, municipal, or other nondomestic use, during at least one of the last 3 years preceding the date of this act and not heretofore abandoned, is hereby declared to constitute a vested right. All claimants to vested rights shall file notice with the State engineer, on forms prescribed by him, within 1 year after the date of this enactment.

SED. 7. The State engineer at any time may hold a hearing on his own motion or upon petition signed by 50 or one-fourth of the users of underground water in any area or subarea, to determine whether the water supply within such area or subarea is adequate for the needs of all permitters and vested right claimants in good standing. If the finding is negative, the State engineer shall order that withdrawals be restricted in order of priority during period of shortage.

SEC. 8. Nonuse of water for 4 successive years by any permit holder or vested right claimant shall work a forfeiture of the right. The State engineer shall hold hearings on forfeitures, following the procedure herein for hearings on applications to appropriate.

SEC. 9. It is the intention of the legislature, by the exercise of the police power of the State, to prevent waste of underground water and pollution and contamination of the underground water supply. The State engineer shall require the proper capping or valves on all wells that will effectively stop the flow of water when not in use under terms of their permits. He shall also require the proper casing, plugging, or capping, of any well which encounters salt water or water containing mineral or other substances injurious to agriculture or such that the commingling of such water with other waters would render the combined waters unsuitable for domestic or agricultural uses. He shall take necessary measures to prevent the loss of underground water above or below the ground surface through leaky pipes or other conduits.

SEC. 10. The State engineer shall prescribe fees for all services provided herein, which shall cover the reasonable cost of State services not defrayed by appropriation or otherwise.

SEC. 11. Any persons or corporations violating any of the provisions of this chapter shall be guilty of misdemeanor and upon conviction thereof shall be fined not less than $10 nor more than $100 for each offense.

APPENDIX C

BASAL SPRINGS — PEARL HARBOR AREA

Source	Operator	Measured Total (M.G.D.)	Local Irrigation (M.G.D.)	Pumped Irrigation (M.G.D.)	Plant Condensers (M.G.D.)	Discharge to Sea (M.G.D.)	Chloride (p.p.m.)
Kalauao Spring	Hon.P.Co.	15.3	?	1.4		13.9	69(a) 80(b) 154(c)
Waiau Springs		6.1(A)	?				138
Tunnel & Wells	H.E.Co.	10.9(B)					136
West Spring Group		8.7(C)	?				
Pool	H.E.Co.	11.7(D)					
Total ABCD	H.E.Co.	37.4		11.0 Hon.P.Co.	36.4	26.4 Kalauoopu	134
Loko Kukona		1.7	?			1.7	1050
Puukapu		3.4	?			3.4	167
Waiawa	O.S.Co.	13.2	?	2.8		10.4	288
Waikele	O.S.Co.	8.0(d)	?	4.7		3.3	
TOTALS		79.0(e)	?	19.9	59.1		

(a) At spring wall.
(b) At pump intake.
(c) At ocean discharge weir.
(d) Based on measurements reported by Kunesh, 1928-1931; conditions believed to be similar in 1944.
(e) With exception of (d), these are measured means for fiscal year 1943-1944, records by U. S. Geological Survey and Hawaiian Electric Company.

Source: Dr. Chester K. Wentworth, Honolulu Board of Water Supply.

APPENDIX D

PRINCIPAL USERS OF GROUND WATER PUMPED FROM WELLS AND SHAFTS
In million gallons annually

	1934[a]	1935[a]	1936[a]	1937[a]	1938[a]	1939[a]	1940[b]
Ewa Plantation	29953	30016	31545	31726	36070	35219	36679.62
Honolulu Board of Water Supply	6200	6280	6320	5960	6160	6200	7487
Honolulu Plantation Company[g]	19020	17535	14756	14484	14716	13992	15139.52
Honolulu Rural Water Works	(h)	(h)	(h)	(h)	(h)	(h)	62.92
Kahuku Plantation Company	5775	6525	6072	6111	6226	7571	8055.63
Oahu Sugar Company	10862.36	10343.22	10557.72	10073.91	9832.06	12776.53	16633.08
Private Wells in Honolulu	4230	4510	4930	5000	5180	5220	4924
Waialua Agricultural Company	17469	14398	12978	14530	14523	13861	17777.19
Waianae Plantation	1534.59	1407.22	1598.03	1591.27	1740.49	1631.85	2255.50
Waialee Trng. School (Dept. of Inst.)	(h)	(h)	(h)	(h)	(h)	(h)	(h)
Waimano Home (Dept. of Inst.)						18.50	(h)
Oahu Prison	40.70	(i)	(i)	(i)	(i)	(i)	(i)
U. S. Army	(h)	(h)	(h)	(h)	(h)	(h)	1230.27
U. S. Navy	(h)	(h)	(h)	(h)	(h)	(h)	2339.56
Haw'n Electric Co. (Waiau Plant)[j]							5691.19
Wahiawa Water Company	(h)	(h)	(h)	(h)	(h)	(h)	(h)
	95084.65	91014.44	88756.75	89476.18	94447.55	96489.88	118275.48

a Info. from Bull. #5, "Supplement to Geology and Ground Water Resources of Oahu."
b Info. from Geological Survey Water Supply Paper #911.
g Includes inseparable amount from Kalauoopu Spring.
h Records unavailable.
i Included in report for private wells in Honolulu.
j Put into service in 1940.

PRINCIPAL USERS OF GROUND WATER PUMPED FROM WELLS AND SHAFTS
In million gallons annually
(Continued)

	1941[c]	1942[d]	1943[e]	1944[f]	1945[f]	1946[f]
Ewa Plantation	41985.32	40035	39816	37599	34807	29889
Honolulu Board of Water Supply	8707	8531	13026.50	13539	13929	13103
Honolulu Plantation Company[g]	14023.23	13546.80	15070.24	14914.21	14806.56	8331.19
Honolulu Rural Water Works	90.74	82.17	82.75	759	871	725.26
Kahuku Plantation Company	11107.58	8175.28	9410.35	11749.25	12750.51	12875.10
Oahu Sugar Company	20242.64	16925.06	15977.01	18386.01	15652.87	11067.74
Private Wells in Honolulu	4884	4773	5289.04	5172.76	11522	9170
Waialua Agricultural Company	19613	13509.53	13715.30	20459.10	21577.24	16739.67
Waianae Plantation	2084.04	1718.59	1659.63	1690.13	1091.75	1147.70
Waialee Trng. School (Dept. of Inst.)	(h)	39.42	36.50	38	37.62	35.50
Waimano Home (Dept. of Inst.)	(h)	(h)	(h)	19.14	30	77.82
Oahu Prison	(i)	(i)	(i)	(i)	(i)	(i)
U. S. Army	1470.72	1496.51	2280.69	2562.54	2731.20	1974.32
U. S. Navy	3212.06	5355.43	8286	11974.96	14117.78	8967.67
Haw'n Electric Company (Waiau Plant)[j]	3769	4127	4181	3859	3675	3396
Wahiawa Water Company	(h)	(h)	(h)	41.72	33.43	12.44
	131189.33	118314.79	128831.01	142763.82	147632.96	117512.41

c Info. from Geological Survey Water Supply Paper #941.
d Info. from Geological Survey Water Supply Paper #949.
e Info. from Geological Survey Water Supply Paper #991.
f From manuscripts awaiting publication by Geological Survey and unpublished reports.
g Includes inseparable amount from Kalauoopu Spring.
h Records unavailable.
i Included in report for private wells in Honolulu.
j Put into service in 1940.

APPENDIX E

GROUND WATER FROM TUNNELS FOR WHICH RECORDS ARE AVAILABLE*
In million gallons annually

	1934	1935	1936	1937	1938	1939	1940
Waiahole Tunnels[a]	(b)	(b)	(b)	11979.88	12386	11200.47	9973.39
Waikane #1							
Waikane #2							
Kahana #1							
Unau #1							
Board of Water Supply[c]	397.85	266.45	292	919.80	1200.85	1054.85	839.50
Manoa Tunnels							
Palolo Tunnels							
Nuuanu Tunnels							
Kalihi Tunnels							
C&C Suburban Water System[d]							
Luluku Tunnels	164	135	163	248	(b)	(b)	231
Waiamanalo Tunnels	(b)	(b)	24	24	26	28	31
Haiku Tunnel	Put into service in 1941.						
Kahaluu Tunnel	Put into service in 1947.						
Waianae Tunnel	Put into service in 1948.						

*In addition, the Navy's Lualualei tunnel developed 142 m.g. in 1947.

a Records obtained from Oahu Sugar Company.
b Not supplied.
c Records obtained from Biennial Reports - Board of Water Supply.
d Records obtained from unpublished reports of the Suburban Water System.

GROUND WATER FROM TUNNELS FOR WHICH RECORDS ARE AVAILABLE*
In million gallons annually
(Continued)

	1941	1942	1943	1944	1945	1946
Waiahole Tunnels[a]	8376.36	9277.97	8639.57	7606.62	7302.41	6621.14
Waikane #1						
Waikane #2						
Kahana #1						
Unau #1						
Board of Water Supply[c]	784.75	1022	817.60	459.90	3335.80	255.50
Manoa Tunnels						
Palolo Tunnels						
Nuuanu Tunnels						
Kalihi Tunnels						
C&C Suburban Water System[d]						
Luluku Tunnels	(b)	(b)	(b)	312	306	233
Waimanalo Tunnels	49	96	84	97	117	(b)
Haiku Tunnel			1208	1343	1138	779
Kahaluu Tunnel	Put into service in 1947.					
Waianae Tunnel	Put into service in 1948.					

*In addition, the Navy's Lualualei tunnel developed 142 m.g. in 1947.

a Records obtained from Oahu Sugar Company.
b Not supplied.
c Records obtained from Biennial Reports -- Board of Water Supply.
d Records obtained from unpublished reports of the Suburban Water System.

APPENDIX F

GROUND WATER FROM TUNNELS FOR WHICH
ONLY ROUGH ESTIMATES OF FLOW ARE AVAILABLE[a]
In million gallons annually

Henry Tunnel	51
Maunawili Tunnels	473.77
Waimanalo Tunnels	15
Kaloi Tunnel	.07
Makakilo Tunnel	.51
Mutual Radio	.07
Lualualei	No estimate available
Waianae Valley Tunnels	1679
Makaha Tunnels	139
Andrews Tunnel	(Flow is mere trickle)
Halawa Tunnels	16
Aiea Tunnel	(Dry)
Schofield	75
Kupihao Tunnels	3.60
Kahuku	(Flow is mere trickle)
C. P. C.	5 to 7

a Converted from estimated daily flow as given by Stearns and Vaksvik in Bulletin #1, Geology and Ground Water Resources of Oahu, pp. 431-434; published in 1935. Flow may be decreased at present. No. records on consumption are available for these tunnels.

APPENDIX G

SURFACE FLOW AND DIVERSIONS OF STREAMS AND SPRINGS WITH GAGING STATIONS
In million gallons annually

	1934[a]		1935[b]		1936[c]		1937[d]		1938[e]	
	Run-off	Diversions	Run-off	Diversions	Run-off	Diversions	Run-off	Diversions	Run-off	Diversions
Rt. Br. of N. F. Kaukonahua	(s)		2090		3050		3930		2690	
Lt. Br. of N. F. Kaukonahua	3440		3180		4240		5110		3840	
Puhawai Stream nr. Lualualei	81.90		113		48.90		76.30		124	
Pearl Harbor Spr. at Waiawa[l]	(s)	50.98	(s)	13.50	(s)	78.16	(s)	192.40	4680	316.45
Pearl Harbor Spr. at Puukapu[m]	1570		(s)		1200		1420		1510	
Pearl Harbor Spr. at Loko Kukona	1000		(s)		951		1090		992	
Pearl Harbor Spr. at Kaluaoopu	6450		6980		6680		(s)		(s)	
Pearl Harbor Spr. at Waiau	2500		2630		2400		3260		3120	
Pearl Harbor Spr. at Kalauao[n]	5210	1694	5640	1494	5470	1438	6860	1245	7150	945
Moanalua Stream near Honolulu	620		646		809		1500		1050	
Kalihi Stream near Honolulu[o]	1780		1720		2030		2830		2250	
Nuuanu Stream below Res. #2[p]	1940		2290		2480		3940		2590	
West Branch, Manoa Stream[q]	670		833		1010		1320		1060	
East Branch, Manoa Stream[q]	758		787		1030		1320		1800	
Pukele Stream[o]	364		400		491		841		738	
Waiomao Stream	321		317		462		766		677	
Haiku Stream near Heeia[q]	(s)		(s)		(s)		(s)		1680	
Iolekaa Stream[r]	(s)		(s)		(s)		(s)		(s)	
Kahaluu Stream	(s)		(s)		1250		1690		1680	
Waihee Stream	(s)		(s)		2460		3260		3140	

a Info. from Geological Survey Water Supply Paper #795.
b Info. from Geological Survey Water Supply Paper #815.
c Info. from Geological Survey Water Supply Paper #835.
d Info. from Geological Survey Water Supply Paper #865.
e Info. from Geological Survey Water Supply Paper #885.
l Diversion by Oahu Sugar Company.
m About a million gallons a day diverted occasionally.
n Water diverted by Honolulu Plantation Company.
o Unknown quantity diverted for domestic use.
p Board of Water Supply diverts water from tunnel in drainage area.
q Insignificant quantity diverted.
r Suburban Water System diverts water from tunnel above station.
s Totals for year either incomplete or unavailable.

SURFACE FLOW AND DIVERSIONS OF STREAMS AND SPRINGS WITH GAGING STATIONS
In million gallons annually
(Continued)

	1939[f]		1940[g]		1941[h]		1942[i]	
	Run-off	Diversions	Run-off	Diversions	Run-off	Diversions	Run-off	Diversions
Rt. Br. of N. F. Kaukonahua	3190		1990		2080		2820	
Lt. Br. of N. F. Kaukonahua	5300		3150		3030		4400	
Puhawai Stream nr. Lualualei	235		58.80		29.9		67.2	
Pearl Harbor Spr. at Waiawa[l]	4850	288.59	4580	(s)	3610	795.37	3650	823.15
Pearl Harbor Spr. at Puukapu[m]	1340		1280		1130		1190	
Pearl Harbor Spr. at Loko Kukona	862		802		696		684	
Pearl Harbor Spr. at Kaluaoopu	(s)		(s)		(s)	3139[t]	(s)	3285[u]
Pearl Harbor Spr. at Waiau	(s)		(s)		(s)		(s)	
Pearl Harbor Spr. at Kalauao[n]	6830	559	6410	548.76	5360	798.63	5520	582.66
Moanalua Stream near Honolulu	1460		360		444		1190	
Kalihi Stream near Honolulu[o]	2300		1280		1210		2200	
Nuuanu Stream below Res. #2[p]	2310		1150		992		2310	
West Branch, Manoa Stream[q]	1360		745		770		1150	
East Branch, Manoa Stream[q]	1600		1210		1160		1670	
Pukele Stream[o]	606		295		262		634	
Waiomao Stream	520		289		300		605	
Haiku Stream near Heeia[q]	(s)		1380		1510		921	
Iolekaa Stream[r]	(s)		(s)		208		162	
Kahaluu Stream	1430		1250		1070		1090	
Waihee Stream	2720		2450		2050		2720	

f Info. from Geological Survey Water Supply Paper #905.
g Info. from Geological Survey Water Supply Paper #935.
h Info. from Geological Survey Water Supply Paper #965.
i Info. from Geological Survey Water Supply Paper #985.
l Diversion by Oahu Sugar Company.
m About a million gallons a day diverted occasionally.
n Water diverted by Honolulu Plantation Company.
o Unknown quantity diverted for domestic use.
p Board of Water Supply diverts water from tunnel in drainage area.
q Insignificant quantity diverted.
r Suburban Water System diverts water from tunnel above station.
s Totals for year either incomplete or unavailable.
t Info. from Geological Survey Water Supply Paper #941.
u Info. from Geological Survey Water Supply Paper #949.

SURFACE FLOW AND DIVERSIONS OF STREAMS AND SPRINGS WITH GAGING STATIONS
In million gallons annually
(Continued)

	1943[j]		1944[k]		1945[k]		1946[k]	
	Run-off	Diver-sions	Run-off	Diver-sions	Run-off	Diver-sions	Run-off	Diver-sions
Rt. Br. of N. F. Kaukonahua	2060		1960		(s)		1820	
Lt. Br. of N. F. Kaukonahua	3070		3140		1717.90		2940	
Puhawai Stream nr. Lualualei	60.60							
Pearl Harbor Spr. at Waiawa[l]	4220	495.31	3370	(s)	3462.50	(s)	3630	(s)
Pearl Harbor Spr. at Puukapu[m]	1380		1130				1040	
Pearl Harbor Spr. at Loko Kukona	677		523		984.90		(s)	
Pearl Harbor Spr. at Kaluaoopu	(s)	3285[v]	10370	2804	6636.80	2506	(s)	2679
Pearl Harbor Spr. at Waiau	(s)		1480		1390.60		(s)	
Pearl Harbor Spr. at Kalauao[n]	5660	650.59	4740	503.94	4133.80	594.17	4590	406.95
Moanalua Stream near Honolulu	576		166		117		289	
Kalihi Stream near Honolulu[o]	1270		866		8655		850	
Nuuanu Stream below Res. #2[p]	1410		421		291.93		553	
West Branch, Manoa Stream[q]	656		475		277		538	
East Branch, Manoa Stream[q]	1240		848		503		695	
Pukele Stream[o]	472		185		97		265	
Waiomao Stream	370		180		102.67		275	
Haiku Stream near Heeia[q]	741		320		214.62		210	
Iolekaa Stream[r]	(s)		85.40		61.73		57.20	
Kahaluu Stream	945		772		646		806	
Waihee Stream	2570		1850		1540		1380	

j Info. from Geological Survey Water Supply Paper #1015.
k From unpublished reports - U. S. Geological Survey.
l Diversion by Oahu Sugar Company.
m About a million gallons a day diverted occasionally.
n Water diverted by Honolulu Plantation Company.
o Unknown quantity diverted for domestic use.
p Board of Water Supply diverts water from tunnel in drainage area.
q Insignificant quantity diverted.
r Suburban Water System diverts water from tunnel above station.
s Totals for year either incomplete or unavailable.
v Info. from Geological Survey Water Supply Paper #991.

APPENDIX H

KNOWN SURFACE WATER DIVERSIONS*
In million gallons annually

	1934	1935	1936	1937	1938	1939	1940
Pearl Harbor Springs at Waiawa	50.98[a]	13.50[a]	78.16[a]	192.40[a]	316.45[a]	288.59[a]	
Pearl Harbor Springs at Puukapu[e]							
Pearl Harbor Springs at Kaluaoopu							
Pearl Harbor Springs at Kalauao	1694[a]	1494[a]	1438[a]	1245[a]	945[a]	559[a]	548.76
Kalihi Stream near Honolulu[g]							
Nuuanu Stream below Reservoir #2[h]							
West Branch, Manoa Stream[i]							
East Branch, Manoa Stream[i]							
Pukele Stream[g]							
Waiomao Stream[i]							
Haiku Stream near Heeia[j]							
Waihee Stream[g]							
East Manoa Ditch[k]	292	246	228	62	49.70		
Alewa Heights Spring[k]	163	179	190	176		155	108
Booth Springs[k]	36.50	40.60	57.30	84.80	78.40	80.80	
Hering Spring[k]	15	14.70	12.10	16.10	14.50	15	11.70
Kahuawai Spring[k]	110	111	115	116	106	107	101
Makiki Springs[k]	101	139	112	176	164	163	58.90
Waikele Spring	1235.78[a]	1091.28[a]	1599.66[a]	1631.82[a]	1491.09[a]	1391.02[a]	

* Diversions shown in Appendix G are also included herein.

a Info. from Bull. #5, "Supplement to Geology and Ground Water Resources of Oahu."
b Info. from Geological Survey Water Supply Paper #941.
c Info. from Geological Survey Water Supply Paper #949.
d Info. from Geological Survey Water Supply Paper #991.
e About a million gallons diverted occasionally.
g Water diverted for domestic use - quantity unknown.
h Board of ater Supply diverts water from tunnels in drainage area.
i Insignificant quantity diverted.
j Suburban Water System diverts water from tunnel above station.
k Source of info. - Biennial Reports - Board of Water Supply.

KNOWN SURFACE WATER DIVERSIONS*
In million gallons annually
(Continued)

	1941	1942	1943	1944	1945	1946
Pearl Harbor Springs at Waiawa	795.37[b]	823.15[c]	495.31[d]			
Pearl Harbor Springs at Puukapu[e]						
Pearl Harbor Springs at Kaluaoopu	3139[b]	3285[c]	3285[d]	2804[f]	2506[f]	2679[f]
Pearl Harbor Springs at Kalauao	798.63[b]	582.66[c]	650.59[d]	503.94[f]	594.17[f]	406.95[f]
Kalihi Stream near Honolulu[g]						
Nuuanu Stream below Reservoir #2[h]						
West Branch, Manoa Stream[i]						
East Branch, Manoa Stream[i]						
Pukele Stream[g]						
Waiomao Stream[i]						
Haiku Stream near Heeia[j]						
Waihee Stream[g]						
East Manoa Ditch[k]						
Alewa Heights Spring[k]	81.80	91	83.90	68.30	53.70	139
Booth Springs[k]	16.20	66	52.10	29	188	44
Hering Spring[k]	18.10	11.10	12	9.59	4.69	8.97
Kahuawai Spring[k]	102	100	92.80	88	89.5	85.80
Makiki Springs[k]	53.30	57.60	55.10	50.10	40.10	45.80
Waikele Spring	1690.97[b]	1414.36[c]	1535.81[d]			

* Diversions shown in Appendix G are also included herein.

b Info. from Geological Survey Water Supply Paper #941.
c Info. from Geological Survey Water Supply Paper #949.
d Info. from Geological Survey Water Supply Paper #991.
e About a million gallons diverted occasionally.
f Info. from unpublished reports - US Geological Survey.
g Water diverted for domestic use - quantity unknown.
h Board of Water Supply diverts water from tunnels in drainage area.
i Insignificant quantity diverted.
j Suburban Water System diverts water from tunnel above station.
k Source of info. - Biennial Reports - Board of Water Supply.

APPENDIX I

DEDICATION OF GROUND WATER TO PUBLIC IN LAWS OF WESTERN STATES

Arizona - Water in definite underground channels belongs to the public. (Arizona Code Ann. 1939, sec. 75-101).

California - All water within the State is the property of the people of the State. (California Water Code, sec. 102).

Kansas - All water within the State is dedicated to the use of the people of the State. (1945 Supp. to Gen. Stats. of Kansas 1935, sec. 82a-702).

Nevada - Water of all sources of water supply, whether above or beneath the surface of the ground, belongs to the public. (Nevada Comp. Laws 1929, sec. 7890). All underground waters belong to the public. (Nevada Comp. Laws, Supp. 1931-1941, sec. 7993.10).

New Mexico - Waters of underground streams, channels, artesian basins, reservoirs or lakes, having reasonably ascertainable boundaries, are public waters and belong to the public. (New Mexico Stats. 1941 Ann., sec. 77-1101).

North Dakota - All waters from all sources of water supply belong to the public. (North Dakota Rev. Code 1943, sec. 61-0101).

Oregon - All water from all sources of water supply belong to the public. (Oregon Comp. Laws Ann. 1940, sec. 116-401). Waters in counties east of the summit of the Cascades, in underground streams, channels, artesian basins, reservoirs or lakes, the boundaries of which may reasonably be ascertained, belong to the public. (Oregon Comp. Laws Ann. 1940, sec. 116-444).

South Dakota - All waters, from whatever source of supply, belong to the public, subject to vested private rights, and except that the owner of land owns water flowing under the surface but not forming a definite stream. (South Dakota Code 1939, sec. 61.0101).

Texas - Waters of the ordinary under flow of every flowing river or natural stream, and of all lakes are property of the State. (Vernon's Tex. Stats. 1936, Rev. Civil Stats., art. 7467).

Utah - All waters, whether above or under the ground, are the property of the public, subject to existing rights to their use. (Utah Code Ann. 1943, sec. 100-1-1).

Washington - All waters belong to the public, subject to existing rights. (Rem. Rev. Stats. Ann. 1931, sec. 7351). Waters naturally in underground streams or channels, artesian basins, underground

Washington (continued) - reservoirs, lakes or basins, whose existence or boundaries may be reasonably established or ascertained, and waters abandoned or forfeited into such bodies, are public ground waters and belong to the public. (Laws 1945, ch. 263, secs. 3 and 4; Rem. Rev. Stats. Ann., 1945 Supp., secs. 7400-3 and 7400-4).

Wyoming - Water of all natural streams, springs, lakes, or other collections of still water is the property of the State. (Wyoming Const., Art. VIII, sec. 1).

Source: Hutchins, Wells A. Selected Problems in the Law of Water Rights in the West. U. S. Department of Agriculture Misc. Pub. No. 418 (1942), pp. 78-80. Mr. Hutchins in November, 1947, kindly supplied the current citations contained herein.

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* LRB - Legislative Reference Bureau
MRL - Municipal Reference Library
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